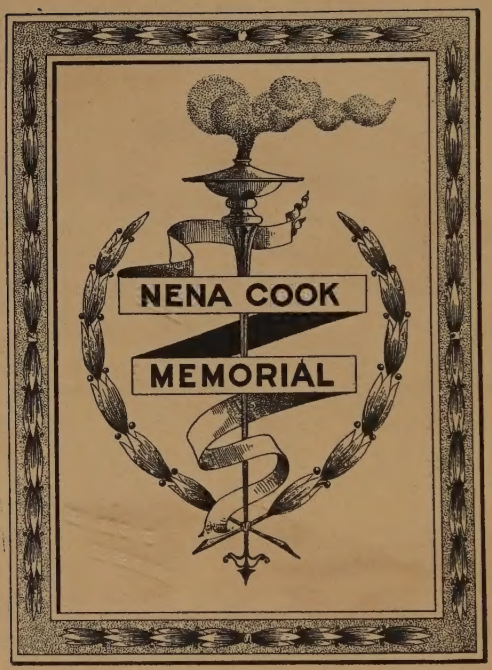
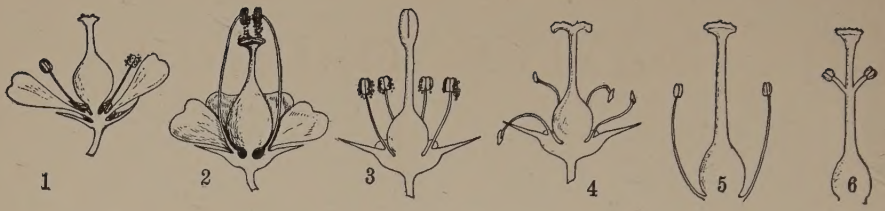
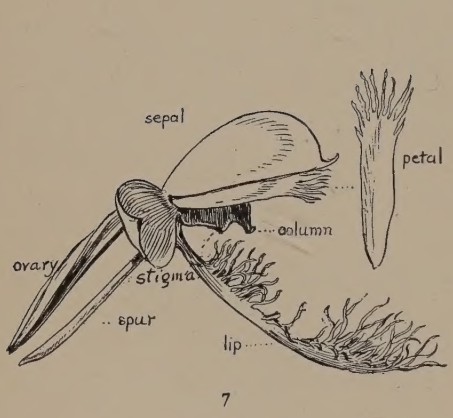
# OUR NATIVE ORCHIDS

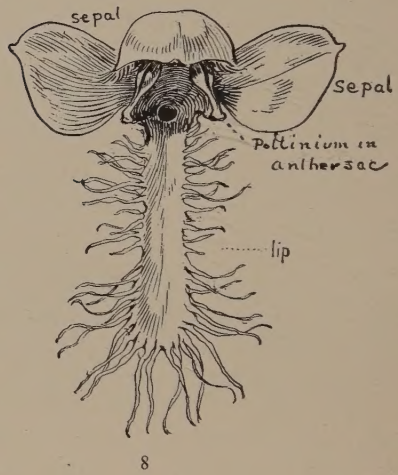
WILLIAM HAMILTON GIBSON

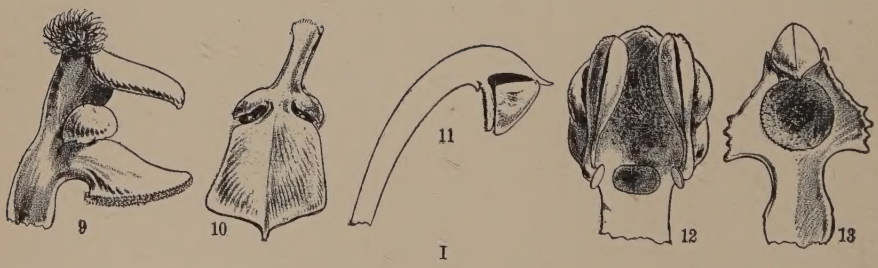

NENA COOK
MEMORIAL

# OUR NATIVE ORCHIDS




Figs. 1, 2, 3 and 4. Stamens as they appear in a regular flower. Figs. 5 and 6. The manner in which stamens may grow to the style. Figs. 7 and 8. Type of an orchid blossom showing the various parts. Figs. 9, 10, 11, 12 and 13. Various types of reproductive organs in the orchids, showing the consolidation of the anther and pistil on the stalk called the column.

# OUR NATIVE ORCHIDS

## A SERIES OF DRAWINGS FROM NATURE OF ALL THE SPECIES FOUND IN THE NORTHEASTERN UNITED STATES

BY

WILLIAM HAMILTON GIBSON

With descriptive text elaborated from the author's notes, by

HELENA LEEMING JELLIFFE

149219

NEW YORK

DOUBLEDAY, PAGE & COMPANY

1905

QR
495
G465

Copyright, 1905, by
Doubleday, Page & Company
Published, June, 1905

*All rights reserved,*
*including that of translation into foreign languages,*
*including the Scandinavian.*

5 8 0
G 3 5

# CONTENTS


PAGE

PREFACE . . . . . v

INTRODUCTION . . . . . xi

ILLUSTRATED KEY TO THE GENERA OF ORCHIDS . . . xxiii

I. CYPRIPEDIUM . . . . . 3

II. ORCHIS . . . . . 19

III. HABENARIA . . . . . 24

IV. POGONIA . . . . . 65

V. ARETHUSA . . . . . 78

VI. EPIPACTIS . . . . . 82

VII. GYROSTACHYS . . . . . 87

VIII. LISTERA . . . . . 103

IX. PERAMIUM . . . . . 111

X. ACHROANTHES . . . . . 120

XI. LEPTORCHIS . . . . . 125

XII. CALYPSO . . . . . 130

XIII. CORALLORHIZA . . . . . 133

XIV. TIPULARIA . . . . . 145

XV. LIMODORUM . . . . . 147

XVI. HEXALECTRIS . . . . . 150

XVII. APLECTRUM . . . . . 151

INDEX . . . . . 155

# LIST OF ILLUSTRATIONS


| PLATE | | FACING PAGE |
|---|---|---|
| I. | Characteristic Organs of the Orchid | *Frontispiece* |
| II. | Type of the Genus Cypripedium | 4 |
| III. | Ram's Head Lady's-Slipper | 5 |
| IV. | Pink Lady's-Slipper | 10 |
| V. | Showy Lady's-Slipper | 11 |
| VI. | Small White Lady's-Slipper | 14 |
| VII. | Small, and Large, Yellow Lady's-Slipper | 15 |
| VIII. | Blossom of Small, and Large, Yellow Lady's-Slipper | 18 |
| IX. | Showy Orchis | 19 |
| X. | Showy Orchis | 22 |
| XI. | Small Round-leaved Orchis | 23 |
| XII. | Type of Habenaria Blossoms | 26 |
| XIII. | Large Round-leaved Orchis | 27 |
| XIV. | Hooker's Orchis | 32 |
| XV. | Small Northern Bog Orchis | 33 |
| XVI. | Southern Small White, and Yellow, Orchis | 34 |
| XVII. | Tall Leafy Green Orchis; Tall White Bog Orchis | 35 |
| XVIII. | Tall White Bog Orchis | 40 |
| XIX. | Long-bracted Orchids | 41 |
| XX. | Small Green Wood Orchis | 44 |
| XXI. | Tubercled Orchis | 45 |
| XXII. | Crested Yellow Orchis | 48 |
| XXIII. | Yellow Fringed Orchis | 49 |

## LIST OF ILLUSTRATIONS—*Continued*


| PLATE | | FACING PAGE |
|---|---|---|
| XXIV. | White Fringed Orchis | 56 |
| XXV. | Blossoms of Fringed Orchis | 57 |
| XXVI. | Smaller Purple Fringed Orchis | 60 |
| XXVII. | Fringeless Purple Orchis | 61 |
| XXVIII. | Blossoms of Rose Pogonia | 64 |
| XXIX. | Rose Pogonia | 65 |
| XXX. | Nodding Pogonia | 72 |
| XXXI. | Spreading Pogonia | 73 |
| XXXII. | Whorled Pogonia | 74 |
| XXXIII. | Smaller Whorled Pogonia | 75 |
| XXXIV. | Arethusa | 80 |
| XXXV. | Helleborine | 81 |
| XXXVI. | Gyrostachys | 88 |
| XXXVII. | Hooded Lady's-Tresses | 94 |
| XXXVIII. | Wide-leaved Lady's-Tresses | 95 |
| XXXIX. | Nodding Lady's-Tresses | 98 |
| XL. | Grass-leaved Lady's-Tresses | 99 |
| XLI. | Slender Lady's-Tresses; Little Lady's-Tresses | 102 |
| XLII. | Typical Flower of the Genus Listera | 106 |
| XLIII. | Broad-lipped, Heart-leaved, and Southern Twayblade | 110 |
| XLIV. | Rattlesnake Plantain | 111 |
| XLV. | Lesser Rattlesnake Plantain | 116 |
| XLVI. | Downy Rattlesnake Plantain | 117 |
| XLVII. | Adder's-mouth | 122 |
| XLVIII. | Large Twayblade | 126 |
| XLIX. | Loesel's Twayblade | 127 |
| L. | Calypso | 130 |
| LI. | Corallorhiza | 131 |

## LIST OF ILLUSTRATIONS—*Continued*


| PLATE | | FACING PAGE |
|---|---|---|
| LII. | Early Coralroot; Large Coralroot | 138 |
| LIII. | Wister's Coralroot; Small-flowered Coralroot | 139 |
| LIV. | Blossoms of Coralroot | 144 |
| LV. | Tipularia or Crane-fly Orchis | 145 |
| LVI. | Limodorum or Calopogon | 146 |
| LVII. | Hexalectris or Crested Coralroot | 147 |
| LVIII. | Aplectrum (Adam-and-Eve or Puttyroot) | 150 |

# PREFACE

THERE are not many subjects in the realm of the classified natural sciences which one is forced to study at first hand. Our libraries have led us to enjoy a comfortable sense of non-observing ease. When our attention has been aroused by some science, and we have felt that mental turning of the key that means the opening of a new door of interest, our first impulse has been to go with the confidence and assurance born of past experience in matters literary and scientific to a good library, and announce that we want to see all the books bearing on our newly discovered interest.

When Mr. Gibson first published his article, and later his book, on Edible Mushrooms, the libraries were overrun with students fired with a new ardour by the delightful glimpse into the world of fungi. Some browsed through the stacks. Some sent to Agricultural Departments of their various states for stray illustrated monographs; some saved their money and bought incomprehensible technical works on European fungi, but all met with the same experience. It was impossible to find any book that told all about all the mushrooms that one could find in a day's walk. The result was that the unsatisfied interest forced people to observe. Mycological clubs became the fad; and

the reports at the meetings were all on original observations. Within two or three years a number of popular books, as well as a number of scientific books written in English not too technical were published, and now any child may have its private library on mushrooms.

When Mr. Gibson's article, "A Few Native Orchids," was published shortly before his death, the libraries again had an influx of visitors all asking for "everything on orchids," but they had nothing to offer except Henry Baldwin's popular monograph on "The Orchids of New England," published some twenty years ago. To the mind prepared by much school training for observing birds, and flowers, and trees, this running account of the orchids as they appeared in successive seasons did not give a sufficiently simple method of determining the orchids as one finds them here and there.

This scarcity of books on the subject of our native orchids is due to the fact that no one has yet observed more than a few of them. When Darwin published his work on the cross-fertilisation of orchids, Asa Gray, his American contemporary, made many observations confirming Darwin's. Other botanists loved the orchids, and described their habitat and even wrote poems about them; but no one has yet done for all our native orchids what William Hamilton Gibson started to do.

He had collected and sketched nearly all of the North American species that he could find east of the Mississippi and north of the Carolinas, and had received many from

friends. Then he settled down patiently to watch by night these curiously constructed flowers that are so marvellously adapted to some particular insect visitor. His written observations were only begun at the time of his death, but his data for observation were ready to be given to his readers.

On opening his orchid portfolio, there appear finished studies of the queenly orchids of our Northern woods, delicate pen-and-ink pictures full of the artist's perception of grace in the grotesque, of the inconspicuous low green orchids, and pencil notes of the greatest accuracy, revealing the mechanism by which the pollen masses were clapped on the head of the eager insect that pushed through the alluring petals to get his honey. It was his desire that others should have the dear delight of walking the fields with seeing eyes, and the woods with understanding; and to that end he had completed the drawings of nearly all our sixty or more native orchids with a hint at the meaning of each, when his work was stopped with the text still unwritten.

But the pictures are the orchids themselves, and with his open portfolio, the flower lover may learn to know them, not merely in the snobbish way in which the social aspirant delights to be able to bow to some one whom he knows merely by name, but with that intimate personal love that lasts through seasons' changes, from the spring awakening out of the brown earth to the quick or tardy bursting forth of the blossom, be it gorgeous and tall, or low and queer and ugly, through its hours of unfolding maturity, when it woos with fringe and flame and nectar its insect visitor, until, its

effort fulfilled, its life question answered, it stands old and stricken in days, silently scattering its seed for the year to come.

The text to accompany the illustrations has been plainly set forth in simple English from Mr. Gibson's notes, from the undescriptive statistics of manuals of botany and from an intimate acquaintance with the wild orchids themselves. It is hoped that others may make the observations on their insect visitors that he had prepared himself to make. The orchids should no longer be a mere Latin-named family of plants to squeeze to death in a press and to mount in withered array in a herbarium, but a group of individuals living in a social relation to the insect world and worthy of the most intimate acquaintance and observation.

To older botanists who are accustomed to call the Rattlesnake Plantain "Goodyera," and the Lady's-Tresses "Spiranthes," it may seem like an innovation to use the names Peramium and Gyrostachys. But the latter, as well as all the scientific names here appended to the popular titles, are the old, true names.

Botanists in Europe decided in 1867, at the Paris Botanical Congress, to let the original name of the genus stand. The date to which they decided to go back was the year of the publication of Linnæus's "Genera Plantarum," 1753. Since that date there had arisen great confusion by giving new names in America as well as all over the world to plants that were already known in Europe, or by making a new genus out of some species that should have been put in a

well-established genus. It had come to pass that some plants had from ten to twenty different names, and again several plants had the same name.

It was decided in 1892, at the Botanical Club of the American Association for the Advancement of Science in Rochester, N, Y., to adopt the code of nomenclature devised by the Paris Botanical Congress and return to the oldest established name for each plant.

The botanical manuals of Gray and Wood naturally contained many names which did not comply with this regulation. It was not until the "Illustrated Flora of the Northern States and Canada," by Britton and Brown, was published in 1896 that the painstaking task was accomplished of revising the names of the 4,000 plants included in this flora. Some of the orchids are among those whose scientific names sound unfamiliar. But the orchid lovers who are disturbed by this change from what they learned at school ten or more years ago may rest assured that the nomenclature of botany is now as firmly established as that of zoölogy.

The area covered by these illustrations of Mr. Gibson extends from the Atlantic Ocean to the 102d meridian, and includes the whole state of Kansas, and northward from the parallel of the southern boundary of Virginia and Kentucky to the northern limits of Labrador and Manitoba.

Thanks are due to Doctor Britton and his associates who materially aided the completion of Mr. Gibson's work by placing all the material of the New York Botanical Garden at

the author's disposal, also to Miss Emma Wadsworth and Miss Lucia Hazen, who selected and prepared for reproduction the studies that Mr. Gibson had made for his projected work.

# INTRODUCTION

THE word orchid has a rich, languorous sound to those who know only the painted blossoms of the florist, poised above their boxes of aerial roots. The tales of primeval forests whose branches are aflame with their high-perched, airy visitors rather lead the novice to fancy that the heart of some unexplored New Hampshire forest will reveal a gorgeous galaxy of blossoms, regal with wide, tinted petals, such as float above the heads of the guests at a princely entertainment. But the truth is that our Northeastern American orchids all grow on the ground, are many of them very plain and inconspicuous, and, although some are lovely in the spike, the individual flowers are small and fragile.

But humble as our native orchids may seem compared with the magnificent specimens of the tropics, and with those that vie with the Black Tulip in bringing enormous prices, ours have all the characteristics of this aristocratic family. The orchids are the nobility of the flower world. They are a race set apart. No common garb is theirs. The lilies and the irises, their next of kin, wear blue—but never orchids. These stand in purple and gold, with all the shades between the faintest gleam of pearl and the intensest crimson violet. "Such is their number and variety,"

Humboldt tells us, "in the valleys of the Peruvian Andes that the entire life of a painter would be too short to delineate all the magnificent forms which adorn those deep recesses."

Like scions of a noble race, they have a curiously devised heraldry and may be known by their horns and antlers, tails and ears, and queerly fashioned crests. Like the lords of feudal days, they are served by many, who in serving serve themselves; for the insects that fetch and carry their pollen live on their lord's bounty in the form of nectar. To some extent all flowers, as all mankind, live according to the same law, but in the orchid race the adaptation is finer. Just as there is more ceremony connected with taking a meal in a baron's castle than at a farmhouse, so there is more ceremony about the orchids' guests. The goldenrod is swarmed with the common striped bugs and flies, but the orchids have each their one or few bidden guests, who come as though specially invited. It is no fox-and-crane feast, for the misfits and loungers of the insect world. The moths that come to an orchid from any part of the world are born to feast from its particular cups. Their coiled tongues are of exactly the same length as the spur that holds the nectar, and their heads are adapted to the space between the pollen sacs.

The social relations of the orchids are, as with man, the tempting and absorbing topic, and their devices to woo the insects, like the charms of a heroine of romance, make us forget that there is a purely domestic and mundane side of life in the orchid's world as well as in the human. The

orchids are obliged to take heed as to what they shall eat and drink as much as to what they shall wear. But like the aristocracy of society who are supposed to know nothing of their kitchens and plumbing, the orchids are supposed to live wholly on air, and never dig into the earth for their food supply. This is true of more than half of the three thousand species that inhabit the earth, true of some of those marvellous fantasies of form and colour that perch like brightly plumaged birds on the high trees of tropical forests. Where are the alchemists who transform the air and sunshine into silk-textured petals dyed with the rarest colours? In the green leaves we find that the chlorophyl grains, those minute round green pigment cells, that colour the leaves, are the analytical chemists, that, in the presence of sunlight split the air and water into their elements and then mix new food compounds for the plants' special needs, much as a skilful cook might make bread or cake or doughnuts by using the same materials in different proportions.

But how can the orchids, living so far from the ground, obtain their water? It might appear that they drew it through the roots that they fasten like talons into the branches of the trees, but that would make them parasites. No, the roots get their water from the moisture in the air, while a few are set aside as grappling hooks to fasten the orchid securely in place.

When a young orchid sprouts from the seed that has lodged in a congenial tree top, it sends out a root tip that flattens itself against the bark, sometimes laying itself along like

a strap, from which it sends out tubular cells that might be called clamp cells. So strongly do they penetrate that when one pulls the outer flakes of bark will come off, but the cells will not loose their hold. A few such roots, however, serve to hold the orchid in place, while the rest, growing out without touching anything, hang down from the tree like long threads, or grow freely in the air in tortuous shapes like ropes. In some orchids regular tassels of such roots hang down.

Simple as the aerial roots seem, they are more complex than the roots that plunge in the earth to pursue their food around stones and through crevices. They are covered by a white membrane composed of perforated cells that absorb water like a sponge. As soon as the air becomes moist, whether from falling rain or humidity, they immediately imbibe its water, and pass it on to chlorophyl cells that are imbedded in the centre, and these in turn with the help of the leaves begin the slow mysterious process of accumulating those chemical treasures that in the fulness of years will perhaps burst into an orchid blossom.

The terrestrial orchids all grow as other earth-growing plants do, with roots closely resembling those of the lily family, sometimes fibrous, sometimes fleshy, sometimes bulbous. In most cases when one of these high-bred epiphetal orchids living on dew and sunshine is brought suddenly to earth, planted in soil and forced to live the life of its more mundane neighbours, it dies, but there are instances of a few aerial species that can adapt themselves to circumstances, and

that will push their roots spontaneously into the soil, cast off their white porous envelopes and thrive upon the food obtained direct from Mother Earth.

It was the poet Goethe who in his youthful pursuit of botany proposed the theory that each circle of the flower, the pistils, the stamens, the petals and the sepals, were but modified forms of leaves, which obeyed the great economic impulse of the universe and had settled down to a scheme of division of labour.

The florists, reversing the order of nature by giving the plants unwonted luxuries such as even temperature and excessive food, have caused them to turn back to their former states, and we can find them in the double state going through all the stages of metamorphosis. Roses will show every grade from petal to stamen, and occasionally the whole blossom reverts back to a tuft of green leaves.

If such metamorphoses are possible, it is not hard to see how the various peculiarly shaped flowers owe their irregular form to the combination or modification of their stamens or petals.

"From the simplest and regular type of flowers," to quote Mr. Gibson's own words, "as in the buttercup, we pass on to more and more involved and unsymmetrical forms, as the columbine, monk's-hood, larkspur, aristolochia, and thus finally to the most highly specialised or involved form of all, as seen in the orchid; the multifarious, multiversant orchid; the beautiful orchid, the ugly orchid; the fragrant orchid, the graceful, homely, grotesque, uncanny, mimetic,

and until the year 1859 the absolutely non-committal and inexplicable flower; the blossom which had waited through the ages for Darwin, its chosen interpreter, ere she yielded her secret to humanity!"

To understand readily the metamorphosed structure of the orchids it will be helpful to recall the parts of a simple regular flower as they appear in their concentric circles, represented in Plate I., Fig. 1. Contrast these with the elaborately varied petals of the Yellow Fringed Orchis as seen in Plate I., Figs. 7 and 8. The orchid family is closely related to the lily and the iris family, and has its parts in threes; but the three parts of each circle are by no means symmetrical. Of the outer circle two sepals are alike, but the third is enlarged, making a hood over the petals. In the next circle two petals are alike, but the third is much elongated, fringed and beautifully marked. This fringed petal is called the lip. It may be pouched as in the Lady's-Slipper, or covered with bristles, or pinched, or toothed, or brilliantly coloured, so that it can in some way attract insects to visit it.

This lip, properly speaking, is the upper petal and would stand up in the air like a banner, were it not that the ovary, which in all the lilies and irises is perfectly straight, is, in the orchid family, with but few exceptions, twisted completely around. This causes the lip to hang, and permits it to become larger and more elaborately modified than the other petals or the sepals.

In the particular orchid in the illustration, Plate I., Figs. 7

and 8, which is a type of the structure of several genera, the lip has a slender curved tube hanging from the point where it joins the ovary. This is called the spur. It is generally filled with nectar, and as the insect alights on the lip, which serves as the threshold of the flower, the opening to the spur lies directly in front of him and under the stamens and stigma.

As a near relative of the lilies and irises we expect to see the stamens and pistils separate from one another, arranged in threes; but in order to concentrate their efforts at the opening of the flower through which the insect approaches its heart, the stamens and style have grown together into one organ called the column. Thus one stalk bears the stigma and the pollen. We can trace the metamorphosis in Plate I., Figs. 5 and 6.

This growing together of the reproductive organs is the feature that distinguishes the orchids from all other monocotyledons. The pressed together, knobby, almost grotesque structure with curiously packed pollen grains in the centre of the flower is the characteristic sign by which the novice may know that he has found an orchid (Plate I., Figs. 9, 10, 11, 12, 13).

The structure of the column is various. In some cases, as in the Lady's-Slipper, there are three anthers, two fertile, packed with pollen masses, on either side of the stigma, and one sterile, like a pointed leaf hanging over the stigma. In other cases there is but one anther containing two pollen sacs, one on either side of the stigma. Sometimes

the column is elongated into a beak that projects over the stigma. This projection is called the rostellum.

The pollen is never of the dry, dusty sort that blows from tree to tree, nor is it even the brilliant powdered gold that is poured forth from the long anther sacs of the lilies. It is gathered in waxy masses that cohere in lumps or clubs, called pollinia, and are generally carried away as a whole by the insect visitors, for with very few exceptions the orchids are wholly dependent upon insects for their perpetuation through seed. They possess no possible resource for self fertilisation if they fail to attract the insects that are especially adapted to enter their honey-throated blossoms. Hence this display of stripes and fringes, of brilliant colours, and of long horns of nectar swung beneath the lip to entice the useful visitors.

Many common wild flowers that are arranged with special reference to cross fertilisation, can nevertheless fertilise themselves if they do not receive pollen from other plants, and although they do not as a rule set so many or such heavy seeds as if they had been cross fertilised, yet they are not threatened with extinction if they have to depend on their own pollen. The orchids have no such provision, and would never mature their seeds did they not receive pollen from neighbouring plants through the medium of insect visitors.

It was because of this fact that Darwin chose the orchids as the exponent of his theory of cross fertilisation with which he astonished the world in 1859.

It seems strange to realise that the facts that are taught in every school in the country should have been, until fifty years ago, a mystery for sages to speculate upon.

It took two hundred years to comprehend the truths that were every day being demonstrated by the flowers of the field. In 1682 Nehemias Grew announced that the pollen of a flower must reach the stigma before it could be fertilised (Plate I., Fig. 2). Linnæus settled the arguments which for fifty years waxed hot over the subject, by proving that it was the pollen that really set the seed of a flower. Thus the functions of the stamens and pistils were satisfactorily disposed of; but nothing was settled concerning the honey, the perfume and the colour of the flower. It was considered quite sufficient to consider that the Creator had made them for the delight of man.

But certain curious spirits speculated on the matter, until the day when Sprengel discovered his great half truth. He found that some flowers were so arranged that the pollen could not possibly fall upon the stigma of the same blossom. In some cases the stamens were much shorter than the stigma, as in Plate I., Fig. 3. Therefore he concluded that the insects that were continually crawling in and out of the blossoms made up to the plant for what seemed to him a natural defect in structure, by transferring the pollen to the stigma of the same flower. It never occurred to him that there was a divine and beneficent reason for preventing the pollen from falling on the stigma of its own flower. The point he tried to prove was everywhere disproved by the

flowers themselves. In some cases the anthers were ripe and shedding their pollen (Plate I., Fig. 3) long before the stigma was open to receive it, and by the time the stigma had opened the anthers were withered (Plate I., Fig. 4). Of what use could an insect be to transfer the pollen from ripe stamens to a hard green stigma? And of what avail was its presence in a flower where the stigma was freshly prepared to receive pollen but where the anther sacs were empty? All that Sprengel's idea lacked was "wings"; the insects did brush the pollen from the anthers, but they had to fly to another flower of the same species to find a welcome for it. Thus Sprengel's great work lay unnoticed till Darwin, on reading it nearly one hundred years later, divined the whole truth, namely, that the reason many flowers were so constructed that they could not fertilise themselves was because they could be better fertilised by pollen from other blossoms of their kind. That insects played an important rôle in the transference of this pollen was evident.

When Darwin in his "Origin of Species" stated that no higher plant could fertilise itself for a perpetuity of generations without a cross with some other individual, he called up on himself a shower of blame and abuse for propounding such a doctrine without giving ample facts; for the botanical world at large held the opinion that when the stamens were so admirably set around the stigma it would be a waste of good logic to argue that the pollen did not fertilise its own flower. Had not Sprengel showed that the insect, attracted by markings and spots, perfume and honey, brushed the pollen

off anthers that did not happen to be conveniently placed in relation to the stigma? If there were some exceptions, as when anthers shed their pollen before the stigma was ready to receive it, or the stigma matured before the pollen, were not these "divine mysteries"?

To prove his theory of cross fertilisation Darwin chose the orchids as his witnesses, the native orchids of England, which are much like those of our own woods. He chose them because they were the "most singular and modified forms in the vegetable kingdom," and he expressed the humble hope that his little work—which is now world famous—"might lead some observers to look more curiously into the native species."

It was with the same hope that Mr. Gibson made his orchid studies; that an introduction to the individuals of this queer curious flower folk might lead to an intimate acquaintance with the marvellous laws that guide their being.

We can picture the English seer in science, with his sons and his friends, watching through years the habits of the orchids, sitting patiently in the garden twilight to surprise the moths that visited them; counting the blossoms of those that set seed, where their chosen insects came freely, against the sterility or feeble fertilisation of those that were doomed to celibacy by a net or bell glass; catching the bumble-bees and moths, and examining the pollen masses that stuck to their eyes and hairs; playing pranks upon the flowers, by gently inserting a lead pencil or a fine bristle at the

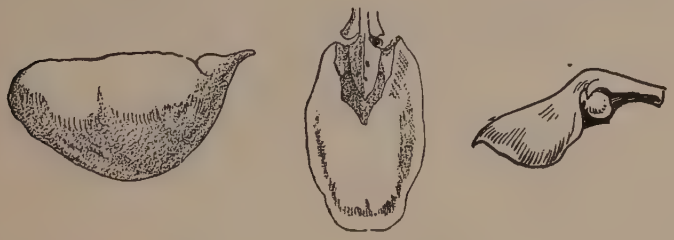
opening of the blossom's throat, and tricking it into yielding up its treasure; exploring the painted pathway to the nectaries, and discovering belated revellers caught drowsing in their cups, when the blossom "shut up for the night."

All this our own science artist did in the woods and fields of Connecticut; and then pictured the orchids whose story he planned to tell, so that each flower lover might learn to know them for himself.

# ILLUSTRATED KEY TO THE GENERA OF ORCHIDS

Flowers solitary or several, large and showy. Lip enlarged into a pouch. Anthers two, one on each side of column.

I. CYPRIPEDIUM P. 3.



Flowers several, purple and white or rose; one anther with two diverging anther sacs. Lip elongated into a spur, pollen masses prolonged into a stalk with a gland.

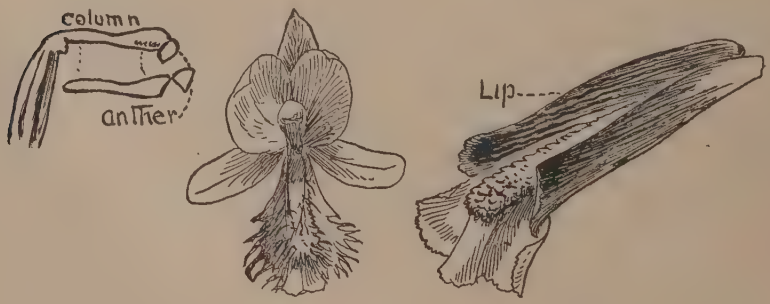
II. ORCHIS P. 19.

Flowers small, greenish, white, purple or yellow; mostly in racemes or spikes; lip with spur at base; anther sacs diverging.

III. HABENARIA p. 24.

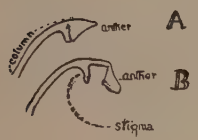
Flowers single or in a loose raceme; leaves alternate or in a whorl; lip without a spur; anther stalked, attached to the back of the column; anther sacs parallel, poilinia without any stalk.

IV. POGONIA p. 65.



Solitary rose-purple flower on a bracted stem; lip without sac or spur; column adhering at its base to lip; anther attached to column with two pollinia in each sac.

V. ARETHUSA p. 78.

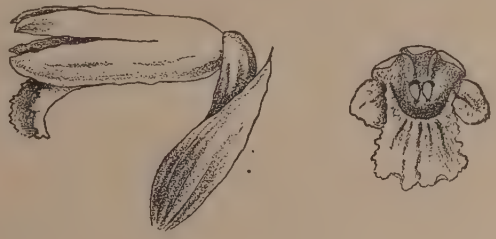


A rare plant with fibrous roots and stout, leafy stem. Flowers in a leafy bracted raceme, with sepals and petals all separate and nearly equal; no spur. Lip pinched in at the middle.

VI. EPIPACTIS p. 82.

Slender herbs with close-pressed white or greenish white flowers arranged in one to three rows on a stalk that is usually twisted; leaves all at the base. Lip, without a spur, but spreading, crisped and cut.

VII. GYROSTACHYS p. 87.



Small herbs with a pair of green leaves near the middle; a raceme of stiff little spurless flowers; sepals and petals nearly all alike, standing free; lip split or expanded.

VIII. LISTERA P. 103.

Flowers in bracted spikes, rising from a tuft of basal leaves, often blotched with white; lip entire, roundish ovate.

IX. PERAMIUM P. 111.

Low herbs from a solid bulb, bearing a raceme of minute feathery white or green flowers. One leaf clasping stalk with several scales below. Two pollinia in each anther sac.

X. ACHROANTHES P. 120.

Low herbs from a solid bulb with a pair of broad, shining leaves at base of flower stalk. Sepals and petals nearly equal, linear and spreading.

XI. LEPTORCHIS P. 125.

Bog herb with coralloid roots; single, purple, pink, and yellow blossom, with a large split, bearded lip.

XII. CALYPSO P. 130.

Root parasites with large coralloid branching roots. Small, inconspicuous, dull flowers in a slender raceme. Leaves all reduced to sheathing scales. Sepals and petals nearly equal.

XIII. CORALLORHIZA P. 133.

Slender herbs rising from solid bulbs. Flowers in a long loose raceme, a single leaf unfolding after the flowers. Flowers green, nodding, with spurs twice as long as the flowers.

XIV. TIPULARIA P. 145.

Several purple pink flowers about one inch long, lip crested with yellow orange hairs.

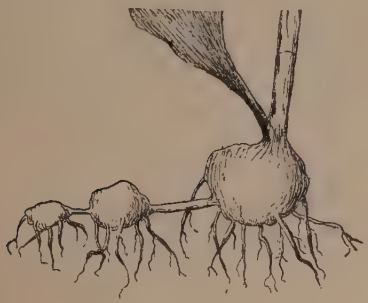
XV. LIMODORUM P. 147.

Stout plant; leaves reduced to scales; coralloid root; large, brownish purple flower, three-quarter inch across.

XVI. HEXALECTRIS
P. 150

Herbs from solid corms, sending up one leaf in autumn. A raceme of nodding, yellow, brown and purple flowers, with sepals and petals equal, no spur.

XVII. APLECTRUM
P. 151



# OUR NATIVE ORCHIDS

# I

## CYPRIPEDIUM

### LADY'S-SLIPPER

THE name Cypripedium comes from κύπρις, Kypris, a Greek name of Venus, and *pes*, *pedis*. The fancy that the long toe-like pouch of a transformed petal looked like a shoe may have led the maids of Athens to call it Venus's Slipper, for a yellow lady's-slipper grows wild in Europe. The same fancy made the Puritan girls that lived on the outskirts of the Indian forests call it the moccasin flower. Our common name of Lady's-Slipper is the outgrowth of the religious custom that followed the Revival of Learning, of making over the personal property of Venus to the Virgin Mary, "Notre Dame." So the name Lady's-Slipper is merely a contraction of "Slipper of Our Lady."

From forests on the islands of the sea, from Java, Borneo, Ceylon and Japan, as well as from India, Mexico and South America, members of this family are brought to the hothouses of Europe and America, and burst out into blossoms of every conceivable shade of purple, crimson, rose and yellow, white and brown and green, every colour except blue, which is denied to the orchids.

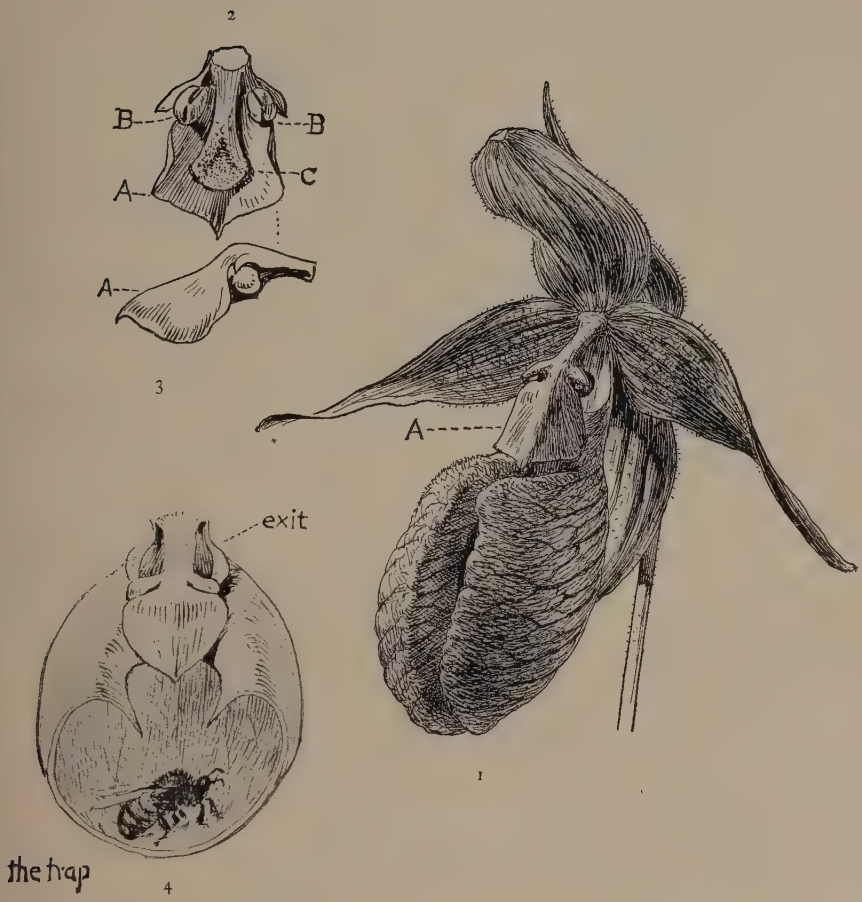
There are at least forty species in tropical and temperate

climes. Only ten grow in North America, and of the wonderful group six in our Eastern woods are among the loveliest of our native orchids. The Cypripedia are so different from all the other orchids that Darwin thought that an enormous wave of extinction must have swept away a multitude of intermediate forms and left this genus, now widely distributed, as a record of a former and more simple state of the great orchidean order.

"The single anther," says Darwin, "which is present in all other orchids, is rudimentary in Cypripedium, and is represented by a singular shield-like projecting body." In the pink Lady's-Slipper (Plate II.) this lies like a little shelf (*A*) just over the stigma (*C*) and almost closes the entrance to the insects' paradise that hangs below.

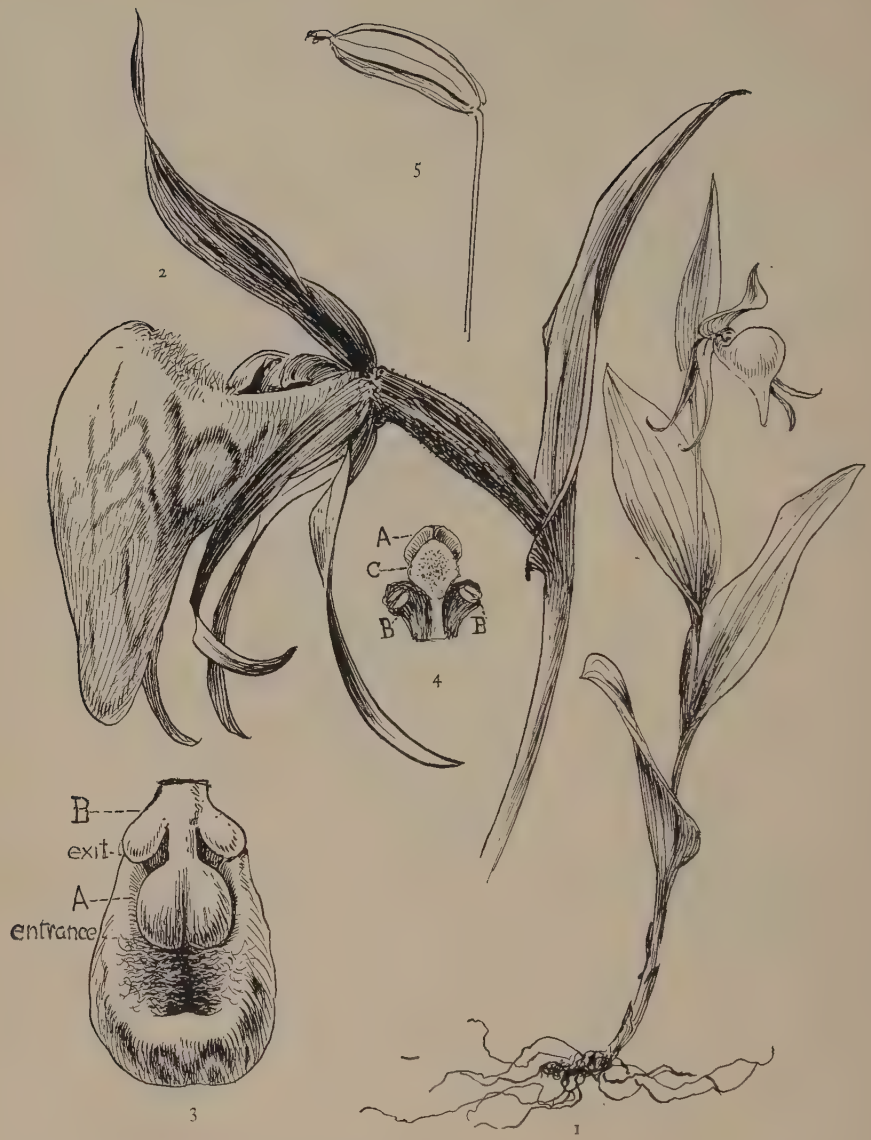
The two fertile anthers lie just behind and beneath this shelf and the stigma is on its under side.

The gorgeously petalled and curiously fashioned flower of a Cypripedium is as unlike the six-parted perianth of the lily or the iris as the court train of a peeress to the simple kirtle of the village maid; and yet it is easy to trace the modifications. There are three outer petals and three inner petals, but all so highly coloured, so beribboned and fluted as to make it difficult to distinguish them. The sepals, however, are the two appendages that stand, the one like a banner directly over the pouch, and the other, formed of two that are almost or wholly united into one, directly under it. Two of the petals are the wings that fly at right angles to the banner, and the third is the curiously blown




II. Type of the Genus Cypripedium, as Seen in the Pink Lady's-Slipper

Fig. 1. The flower. Fig. 2. The stigma and stamens lying under the sterile anther. Fig. 3. Side view of anther. Fig. 4. Interior of pouched lip.




III

Fig. 1. Ram's Head Lady's-Slipper. Fig. 2. Blossom enlarged. Fig. 3. Upper view of anthers and stigma. Fig. 4. Under view of anthers and stigma. Fig. 5. Mature capsule.

pouch called the labellum or lip, within which many a bumblebee finds a sweet tavern. But he does not escape paying his toll unless he bites or claws or bursts his way through the painted walls, as many an unmannerly guest does.

In the illustration (Plate II.) we may see how excellently this orchid has adapted itself to its insect visitors by a division of labour. Instead of three or six stamens, all fashioned alike, as in the lilies and irises, we find a curious combination of stamens and stigmas that at first appear contorted and squeezed together, but that are most cunningly adapted to divide the labour. One stamen is sterile (*A*), but far from being useless, it is spread out into a triangular roof that covers the opening to the labellum, so that no water may drip into the exquisite chamber, and the two anthers (*B*), filled with pollen and stigma (*C*), as seen from the under surface in Fig. 3, are kept dry.

The pollen that lies in these anthers is a pulpy, powdery mass, and so sticky that as an insect brushes by the openings of the anther cells it cannot fail to carry some off with it. Immediately under this improvised stamen roof lie the three stigmas united into one (*C*) and covered, not with a smeary, viscid secretion, but with a comb of teeth that scrapes the pollen from the back and head of any large insect that tries to squeeze his way in at the radiantly coloured but low-eaved portal.

Once he is in (Fig. 4) and has sipped up the secretion that exudes from the hairs that line the inner surface of the

labellum, he finds that those pink-veined edges that lured him in curve hopelessly away from the daylight; but he is not left in despair, for the hairs inside serve as a guide, they all point back and up to a pair of narrow side doors, plainly marked exit, through which he can squeeze. But woe be to him if he is vain of his velvet coat, for he will surely smear it with pollen as he crawls past either of those open anthers. However, he will be rubbed clean by the stigma that hangs like an inverted door-mat at the entrance to the next blossom.

The object of the brilliant veins and spots that converge to the incurved opening of the pouch is to coax the bee to squeeze under the stigma, thereby brushing it with the pollen of the last flower he visited. When he is once in he cannot scramble out any other way than through the small opening directly under the anthers, so that he must perforce take pollen with him to the next blossom, and perform, all unconsciously to himself, the mysterious rites of cross fertilisation.

Mr. Gibson proved the actual passage of the bumblebee by a simple experiment, which any one might repeat. He had observed the torn and bruised lip occasionally perforated by a hole, and he had long patiently watched in the haunts of the Cypripedium, awaiting a natural demonstration of its cross fertilisation.

"At length," he writes, "in hopelessness of reward by such means, I determined to see the process by more prosaic methods. Gathering a cluster of the freshly opened flowers

which still retained their pollen, I took them to my studio. I then captured a bumblebee, and forcibly persuaded him to enact the demonstration which I had so long waited for him peacefully to fulfil. Taking him by the wings, I pushed him into the fissure by which he is naturally supposed to enter without persuasion. He was soon within the sac, and the inflexed wings of the margin had closed above him. He is now enclosed in a luminous prison, and his buzzing protests are audible and his vehemence visible from outside the sac. Let us suppose that he at length has become reconciled to his condition and has determined rationally to fulfil the ideal of his environment, as he may perhaps have already done voluntarily before. The buzzing ceases, and our bee is now finding sweet solace for his incarceration in the copious nectar which he finds secreted among the fringy hairs in the upper narrowed portion of the flower. Having satiated his appetite he concludes to quit his close quarters. After a few moments of more vehement futile struggling and buzzing, he at length espies, through the passage above the nectary fringe, a gleaming light as from two windows. Toward these he now approaches. As he advances the passage becomes narrower and narrower, until at length his back is brought against the overhanging stigma. So narrow is the pass at this point that the efforts of the bee are distinctly manifest from the outside in the distention of the part and the consequent slight change in the droop of the lip. In another moment he has passed his ordeal, and his head is seen protruding from the window-

like opening on one side of the column. But his struggles are not yet ended, for his egress is still slightly checked by the narrow dimensions of the opening, and also by the detention of the anther, which his thorax has now encountered. A strange etiquette this of the Cypripedium, which speeds its parting guest with a sticky plaster smeared all over its back."

This genus is the easiest of our American orchids to name. The pouch, or labellum, is the sign that they belong to the genus Cypripedium, and their colour indicates the species to which they belong.

KEY TO THE SPECIES OF CYPRIPEDIUM

| | |
|---|---|
| Greenish, with purple streaks. | 1. Ram's-head Lady's-Slipper. |
| Pink or rose purple. | 2. Pink Lady's-Slipper. |
| White. | 3. Showy Lady's-Slipper. |
| | 4. Small White Lady's-Slipper. |
| Yellow. | 5. Large Yellow Lady's-Slipper. |
| | 6. Small Yellow Lady's-Slipper. |

### 1. RAM'S-HEAD LADY'S-SLIPPER

*Cypripedium arietinum*, R. Br. (Plate III.)

The rarest of our native Cypripedium is the tiny Ram's-head, *Cypripedium arietinum*. Through the northern part of New England, New York and Minnesota it grows shyly in cold, damp woods or under pines and cedars, blooming from May until August, according to locality. It is unable to attract, by reason of its less conspicuous flower, any but

those who know the interest of its pedigree. It is a connecting link between Cypripedium and other orchids, in the fact that it has three separate sepals, instead of having the two under sepals joined in one, giving the characteristic appearance of only two.

The plant grows from eight to twelve inches in height and has three or four dark green leaves and one little fragrant blossom with narrow green-brown petals (Fig. 1). The lip is an oddly shaped pouch covered with converging hairs at the mouth and mottled with streaking veins in reddish purple. When it is held in a certain position the blunt nose and the curving petals resemble the tiny horned head of a ram.

It is quite common in the orchids of the tropics and conservatories to find horns, anthers, antennæ, tails, ears and other adjuncts, "enough," as one botanist said, "to give a zoölogist the agonies." "The Espiritu Santo seems a white dove with expanded wings, and the droll *Aceras Anthropophora*, dressed like an acrobat in skin-tunic of green, swings as if gibbeted in company with some fifty other little felons." The Ram's-head Cypripedium is the only caricature among our native orchids; and so few have seen it that no one knows much about its domestic life. The broad, sterile stamen (*A*) lies over the stigma (*C*) and shields the entrance, and the anthers (*B*) are tucked snugly into the corners by the exits, as in the other members of the family, but what insects go in and out and whether they are abroad by day or night, no one has written.

## 2. PINK LADY'S-SLIPPER, MOCCASIN FLOWER, NOAH'S ARK, STEMLESS LADY'S-SLIPPER

*Cypripedium acaule*, Ait. (Plate IV.)

THE spring is not perfect to the lover of May who does not find the Pink Lady's-Slipper. It has a roving fancy and grows up hill and down dale. In Virginia it climbs to a height of 4,500 feet. Although it grows chiefly in dry or moist woods, and seems to prefer places where it can grow on the long green graves of fallen pines, yet it is often found in clefts of rocky cliffs and on sunny hillsides and in sandy soil, and it has been found growing in swamps, pale in colour but perfectly healthy. It has been found during the first week in May in our Northern spring. Thoreau has it down in his journal as due on the 20th. The city-bound flower lover who escapes to the woods for the first time on Decoration Day is almost sure to find it in full blossom, and it often lingers through June. From the thick, fleshy root spring two large, cool, oval leaves. They are sometimes eight inches long and one-third as wide. Between them rises a slender stalk, for it is not the flower but the plant that is stemless, and on it hangs the crisp pink pouch of this fragrant blossom of Venus. The inflated lip or labellum gives the predominating tone, but the other parts are toned in harmony. The sepals, the single one above, and the two joined in one beneath, are greenish purple, as also are the two long tapering petals that spread on either side of the third which has been so curiously infolded into the purple

IV. Pink Lady's-Slipper

V

Fig. 1. Showy Lady's-Slipper. Fig. 2. Blossoms about natural size. Fig. 3. Upper and side view of anthers and stigma.

pink pouch threaded with bright crimson veins and lined on its upper inner surface with long white hairs (Plate II. and Plate IV). This pouch is often two inches long, making the largest flower of any of our native orchids.

### 3. SHOWY LADY'S-SLIPPER

*Cypripedium reginæ*, Walt. (Plate V.)

THE glory of all the Cypripediums, in fact the glory of the summer swamps of our Northern woods, is the *Cypripedium reginæ*. Why call it the Showy Lady's-Slipper when it is in truth a queen? It has nothing of the gay and gaudy effect that the former name *spectabile* conveys, nor was its English name *album* good, for it varies from a deep pink purple streaked with white to pure white. It is too regal for a common name, and *Cypripedium reginæ* is the only title worthy of it.

Through the dark shades of our Adirondack forests and in wet woods from Nova Scotia to Georgia it rises on its stout leafy stem, fully two feet high, bearing above its broad-ribbed leaves one or two, and sometimes three or even four lovely blossoms.

In some parts of Maine there are whole swamps where one may wade through the stately plants up to one's knees; but such profusion is rare, and the novice who is just beginning to know the typical bright green rounded leaves of the orchids may think he is plunging into their Paradise when he has found a bog, green with the stout, leafy young plants of false hellebore.

The most appropriate home of *Cypripedium reginæ* is in the Adirondacks, where the sun-dew spreads its jewelled crimson leaves, where the tall royal flowering fern stands as its water guard, and where the hemlocks leave sunny spaces between their branches for the light to shine on the fluttering blossoms.

The plants begin to bloom in June, the earliest being found in Connecticut about the middle of the month, and in the Adirondacks and White and Green Mountains in July, while they are occasionally seen as late as September.

The tall stem is round and covered with fine hairs that droop on the upper part, but are bristly below. It stands erect, clasped hand over hand by sheathing leaves, until just below the flower stalk where there is a slight bend that gives the flowers their characteristic poise. The leaves are broad and oval, measuring from three to seven inches long, and narrowing with the hairy covered veins to a sharp point. Their margins have strong, wavy curves, and their colouring is a rich brilliant green, a little lighter on the under side than on the upper.

A smaller leaf serves as a bract for the flower and stands erect above the drooping blossom. What appears to be the stalk of the flower above this bract is the swollen, fine-ribbed, curved ovary that looks like a miniature squash or cucumber.

The blossom looks as though it had four white petals and a pouch. But the large oval banner that stands erect about the pouch is one of the three sepals, the other two

being joined throughout their length to hang as one under the pouch.

At right angles to the sepals is a pair of narrow, white, delicately curved petals. Below them hangs the pouch. It is a beautiful, hollow, shell-like thing, fully an inch across and an inch deep, and more than an inch long. Spots of mauve purple sprinkle its inner surface and show through its transparent milk-white walls. They converge into a delicate network of veins that grade softly into a tone of mauve that grows more intense as it rounds over the incurved arch that forms the mouth. Into this the bee or insect finds its way, attracted by the brighter purple spots within, but when, after licking the nectar from the hairs that line the pouch, he tries to climb up the vaulted sides toward the orifice by which he entered, he finds himself in a trap. His only chance of escape is through the small curved openings directly under the pollen masses. These stick to his coat as he pushes past, and as he tries to enter another flower are scraped off by the sticky brush of the thick, white, fleshy, heart-shaped stigma.

In some Cypripedia of Europe that are much like these of the American woods, naturalists have found small bees and flies dead in the lovely labellum, because they were not strong enough nor clever enough to push their way through the narrow openings to daylight. Small beetles are sometimes stuck fast by the pollen masses and meet their death. Doubtless we might find such tragedies at home, did we watch the retinue that visit this flower. Swarms

of a minute flower beetle have been noticed going in and out for honey, some of which could scarcely walk straight for the sticking pollen, and on all the flowers visited a magnifying glass showed little specks of pollen on the stigma, and on opening the ovary later all the seeds were fertilised.

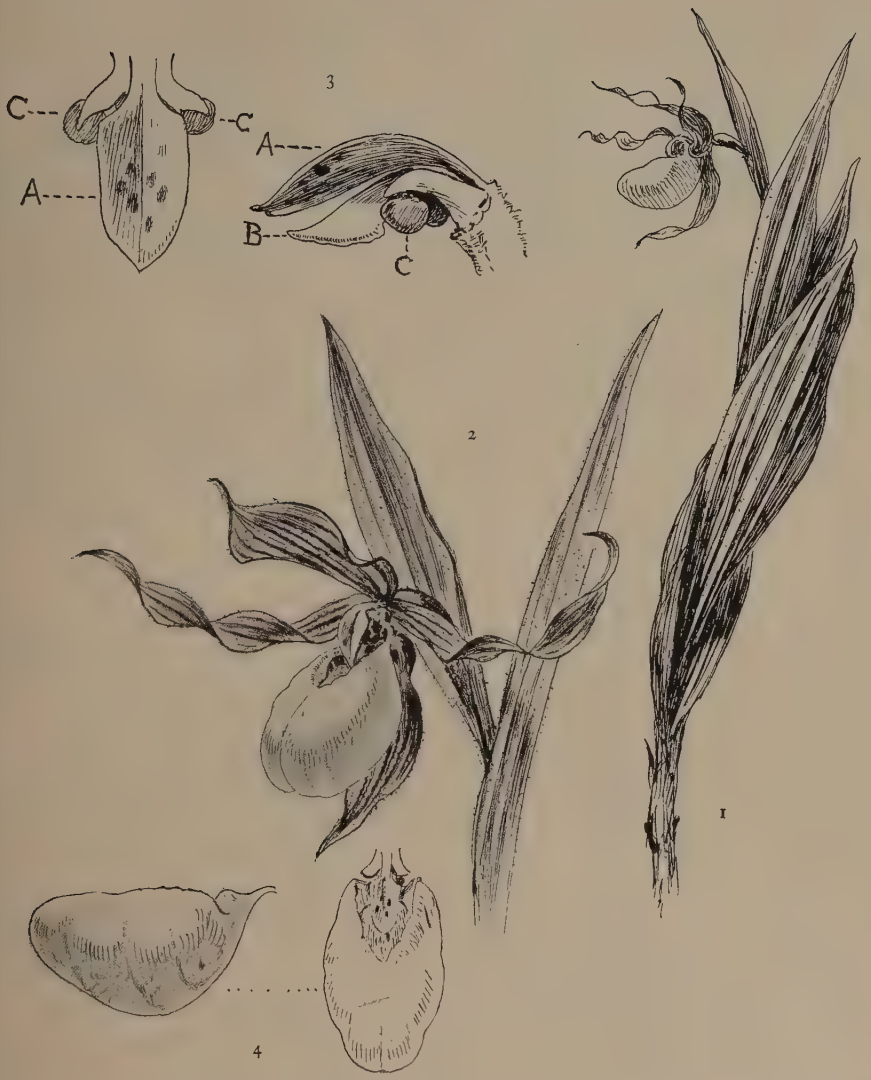
A well-known botanist once found one blossom on a stalk with others that had reverted from this grown-together, irregular type to what we suppose must have been the ancestral regular type of the orchid progenitors. The two lower sepals were separate, and there were three white petals and no lip, so that the flower looked very like some member of the lily or iris family, to which the orchids are closely allied.

### 4. SMALL WHITE LADY'S-SLIPPER

*Cypripedium candidum*, Willd. (Plate VI.)

The Small White Lady's-Slipper grows in the bogs and meadows of New York, New Jersey and Minnesota, but not in the New England States. It may be easily recognised, because it is the only other white Cypripedium beside *reginæ*, and it could never be mistaken for it, because it is small, less than a foot high, has a solitary blossom, and the two winged petals on either side of the lip are long and wavy-twisted, instead of oval. It blooms in May and June.

The three or four leaves are quite narrow and sharply pointed, not much more than an inch wide to their three or five inches in length. They stand more stiffly erect than do the leaves of the *Cypripedium reginæ*, and sheath the




VI

Fig. 1. Small White Lady's-Slipper. Fig. 2. Blossom about natural size. Fig. 3. Front and side view of leaf-like spotted anther. Fig. 4. Front and side view of lip.

VII

Fig. 1. Small Yellow Lady's-Slipper, showing longer, more twisted petals. Fig. 2. Large Yellow Lady's-Slipper.

stem from which the flower peers out above its long, narrow bracts.

The two sepals above and below the lip are longer than the lip, and are covered with minute hairs; and the two twisted petals on either side are still longer and narrower than the sepals and are greenish in colour.

The lip, a neat little white pouch (Fig. 2) less than an inch long, is striped with purple inside and has a sign-post at its entrance in the spotted spade-like shield of the sterile stamen (Fig. 3, *A*) that points invitingly inward and down to the opening of the lip.

In this species the sterile stamen has a short stalk, and one who has followed out the theory of metamorphosis that Goethe proposed in his youth, that the stamens as well as all the parts of a flower are but metamorphosed leaves, can see how this bright leaf-like stamen might roll up to form two anther cells were it not doomed to sterility for the sake of protecting the underlying stigma (Fig. 3, *B*) and these two anther cells (*C*) that must always remain open on the strength of a chance insect visitor.

### 5. LARGE YELLOW LADY'S-SLIPPER

*Cypripedium hirsutum*, Mill. (Plates VII. and VIII.)

THERE are two yellow Cypripedia, so crisp and fresh with their inflated pouches, so cool between their oval clasping leaves, so sprightly on their tall leafy stems, that they are to our American woods what the daffodil is, in the

spring, to the woods of England, though one never sees "a thousand at a glance." They add the joy of rarity to their beauty. They are not so rare but that any one might find them in the Eastern woods and thickets and mountain places in the early summer as far south as Virginia, and yet not so common but that each blossom seems a prize. They bloom from May to July.

*Cypripedium hirsutum* has a leafy stem from one to two feet high and oval, pointed leaves, sometimes five inches long and three wide. As its name implies, it is covered with down or hairs. Fluttering from the top of this leafy spire are one or two pale yellow blossoms. Two sepals, the lower one split at the tip and yellowish green and striped with purple, are balanced by two curled and twisted narrow petals of the same colour. In the centre of these ribboned petals hangs a pale yellow pouch (Plate VIII., Fig. 2), one or two inches in length and spotted with purple. A tuft of white jointed hairs lies inside just at the top, and the triangular sterile stamen (*A*) covers the incurved stigma (*C*).

John Burroughs says that there is a heavy oily odour about this orchid.

Darwin tried the experiment of putting a small bee to work on a blossom of *Cypripedium pubescens*. "The insect entered by the upper opening and attempted to crawl out the same way, but always fell backward, owing to the margins being inflected. The bee could not creep out through the slit between the folded edges of the labellum, as the elongated, triangular, rudimentary stamen here closes the passage.

Ultimately it forced its way out through one of the small orifices close to one of the pollen masses (*B*), and when caught was found smeared with the glutinous pollen."

It has been noted that on tearing the lip of the Yellow Lady's-Slipper apart, there are several crescent-shaped translucent spots on the back of the labellum, through which the light can shine more brightly and that help to lead the imprisoned bee back to where he can catch a glimpse of the real daylight up above him on either side of the anthers.

There is in France a Yellow Lady's-Slipper called "*Sabot de la Vierge*," and "*Soulier de Nôtre Dame*," that is very like *Cypripedium pubescens*, but has a broad band of hairs on the floor of the labellum. "These," says Müller, who has watched thousands of insects pay their visits to the plants, "seem to help the bees to climb up toward the orifices, besides attracting them by their secretions."

### 6. SMALL YELLOW LADY'S-SLIPPER

*Cypripedium parviflorum*, Salisb. (Plates VII. and VIII.)

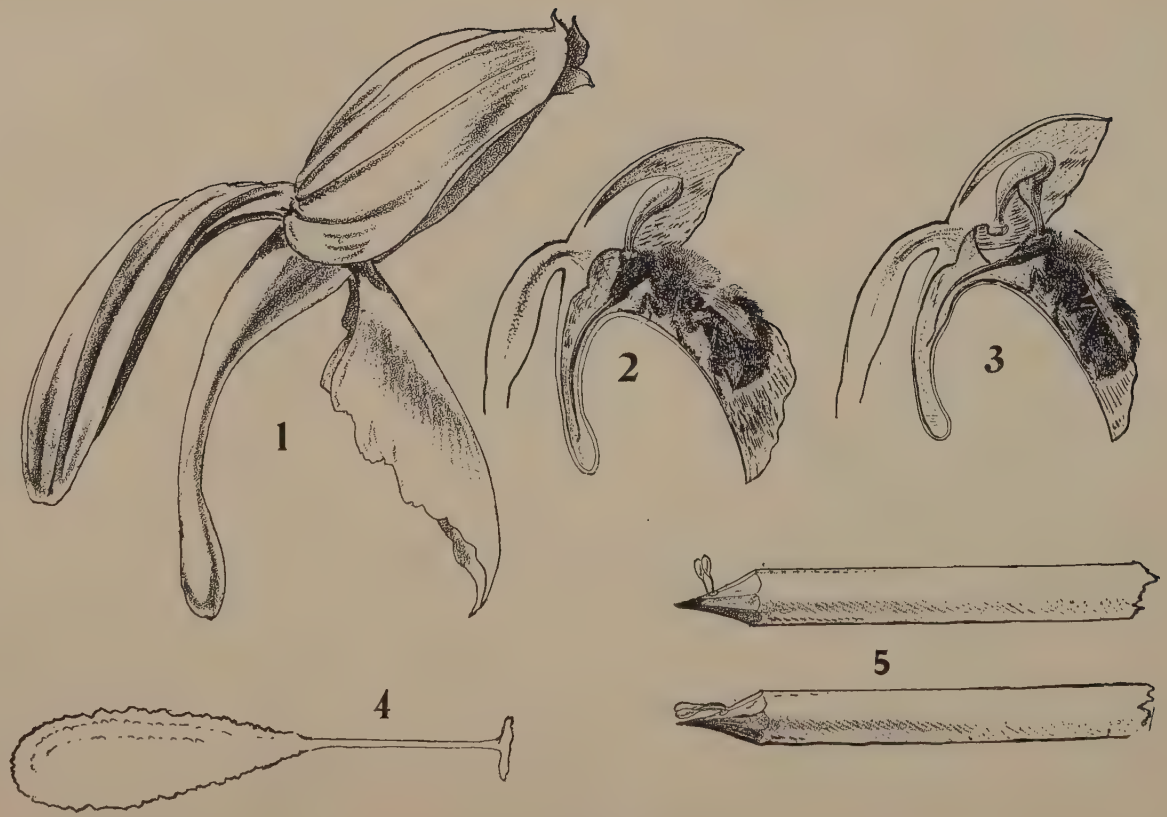
THE smaller Lady's-Slipper resembles the larger in every general description, but can always be distinguished from it if the two species are seen together. They bloom at about the same time, and in the same woods. The smaller species is rarer and roves wider, extending from Newfoundland to British Columbia, while the larger one is easier to find, but only from Nova Scotia to Minnesota.

The smaller Yellow Lady's-Slipper (Plate VII., Fig. 1)

has narrower leaves, a sweeter fragrance, longer and more twisted petals (Plate VIII., Fig. 1), a deeper, richer shade of gold than the larger Yellow Lady's-Slipper. Its little pouch is rarely more than an inch long, and is more brilliantly marked. "Purple spots," the botanists say when they wish to describe the flecks and streaks that mark these lovely pouches, but a clear, dark reddish brown seems nearer. The colour of claret, of a wine-red autumn leaf, is what these yellow Cypripediums bear, but purple they will call it; so must we, only we know what we mean by it.

VIII

Fig. 1. Blossoms of Small Yellow Lady's-Slipper, with detail of lip and anther. Fig. 2. Blossoms of Large Yellow Lady's-Slipper, with detail of anther and stigma.




IX. Showy Orchis

Fig. 1. Side view of blossom. Fig. 2. Bee entering and striking sticky discs. Fig. 3. Bee withdrawing pollen masses. Fig. 4. Pollinium. Fig. 5. Pollen masses artificially withdrawn on lead pencil.

## II

## ORCHIS

This genus, which bears the name of the family, has about eighty species growing in the north temperate zone, but only two of them are known in North America. The flowers are very like those of the great genus Habenaria, but larger and more individual instead of being lost in the effect of the wand or spike which is characteristic of the Habenarias.

In the genus Orchis the plants have fleshy, fibrous roots, and in our species the stems consist of the flower stalk rising from one or two large leaves. The sepals and petals look much alike, are about equal in size and separate. The lip is elongated into a spur. The blossoms are beautiful in colour and shading, being purple and white or rose coloured.

The anther is two-celled. The two pollen masses or pollinia lie one in each sac, slightly diverging from one another. The end of each pollen mass is drawn out into a slender stem, to which is attached a small sticky gland, the function of which is described on page 21.

The capsule is oblong, erect and without a beak.

The two North American species of Orchis may be distinguished from each other as follows:

| | |
|---|---|
| Plant two leaved at base, flowers large, purple and white. | 1. Showy Orchis. |
| Plant one leaved at base, flowers smaller, petals rose colour, lip white spotted with purple. | 2. Small, Round-leaved Orchis. |

### 1. SHOWY ORCHIS

### *Orchis spectabilis*, L. (Plate X.)

Among the earliest flowers of the spring, after the hepaticas and blood-roots show their frail blossoms, one may begin to look for this true harbinger of warm weather. Anywhere in rich woods from New Brunswick to Ontario and Minnesota, and as far south as Georgia, one may find it, if one is fortunate, pushing its two thick green leaves up through the moist matted carpet of the woods and sending up a scape of beautiful pinkish purple and white flowers.

The Showy Orchis does not grow very tall. Its fleshy five-angled stem is not more than twelve inches, and rarely attains even that height. The leaves are, however, comparatively large, sometimes eight inches long and four wide. They are clammy to the touch and spread widely when the flowering scape appears.

There are seldom more than three to six blossoms, but each is about an inch long. Leafy bracts sheathe the ovaries, and the white sepals unite in an arch bending over the anther cells in such a way as to give the name "Preacher in

the Pulpit" to the orchid, from the fancied resemblance to two little men standing in a canopied pulpit.

The inward mechanism of this orchid is most interesting. In its arrangement for attracting insects, no silken chamber lures the insect in, but a horn of honey is offered to whoever will apply his wits to get it.

In Mr. Gibson's notes we read: "In the Showy Orchid we have what would appear a clear adaptation to the head of the bee, though one which might also avail of the service of an occasional butterfly." An enlarged view of the blossom is seen in Plate IX., Figs, 1, 2 and 3.

"I have seen many specimens with the pollen masses withdrawn, and others with their stigmas well covered with the grains. Though I have never seen an insect at work upon it in its haunt, the whole form of the opening of the flower would seem to imply a bee, particularly a bumble-bee. If we insert the point of a lead pencil into this opening, thus imitating the entrance of a bee, its bevelled surface comes in contact with the viscid discs by the rupture of a veil of membrane, which has hitherto protected them. The discs adhere to the pencil and are withdrawn upon it (Plate IX., Fig. 5). At first in upright position, they soon assume the forward inclination as previously described. The nectary is about the length of a bumblebee's tongue, and is, moreover, so amply expanded at the throat below the stigma as to admit its wedge-shaped head comfortably.

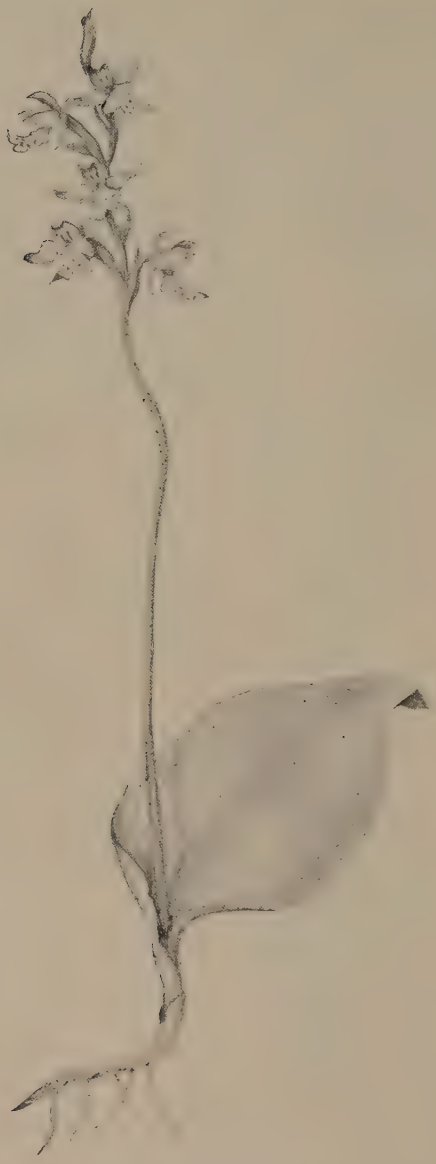
149219

"The pollen discs are here very close together, and are protected within a membranous cup, in which they sit as in a socket. As the insect inserts his head at the opening (Plate IX., Fig. 2) it is brought against this tender membrane, which ruptures and exposes the viscid glands of the pollen masses. These become instantly attached to the face or head, and perhaps to the eyes of the burly visitor. As the insect retreats from the flower, one or both of the pollinia are withdrawn, as at Plate IX., Fig. 3. Then follows a downward movement, which exactly anticipates the position of the stigma, and as the bee enters the next flower the pollen clubs are forced against it.

"In the case of a smaller bee visiting the flower, the insect would find it necessary to creep further into the opening, and thus might bring its thorax against the pollen glands. In either case the change of position in the pollinia would insure the same result.

"We have thus seen adaptation to the thorax, the eyes and the face in the examples given. And the entrance of the flower in each instance is so formed as to insure the proper angle of approach for the insect for the accomplishment of the desired result. This direct approach, so necessary in many orchids, is insured by various devices—by the position of the lip upon which the insect must alight; by the narrow entrance of the throat of the flower in front of the nectary; and by a fissure in the centre of the lip, by which the tongue is conducted."

X. Showy Orchis



XI. Small Round-leaved Orchis

### 2. SMALL ROUND-LEAVED ORCHIS

*Orchis rotundifolia*, Pursh. (Plate XI.)

For a long time *Orchis spectabilis* was the only one of the eighty known species to represent the genus in North America, for its true sister was called *Habenaria rotundifolia*, but now the Small Round-leaved Orchis (Plate XI.) is put in its place in the genus Orchis. It is a delicate, pretty little plant growing in cedar woods and ferny places, and loving the cold and damp. It grows only in our Northern States, but has travelled as far as Greenland.

Its one leaf is oval or nearly round, from one and a half to three inches long. The spike, which is about eight inches tall, has from two to six minute pale whitish flowers. The small three-lobed lip, with tiny purple flecks, is larger than the petals, and has the middle lobe cleft or divided. The spur is slender and shorter than the lip. It is by no means as attractive as the Showy Orchid, or as other wonderful foreign specimens belonging to the genus; but it has the same interesting but infinitesimal mechanism as its sister. It blooms in June and July.

## III

## HABENARIA

(Plate XII.)

The genus Habenaria, or Rein-Orchis, as the Greek name signifies, is a group whose external characteristics are leafy stems and a wand of many flowers. There are some four hundred species in different parts of the world, and beside the eighteen included in our northeastern limit there are perhaps twenty others in the southern and western parts of North America.

The genus Habenaria contains some of the larger plants of our American orchids. They have substantial fibrous or tuberous roots and round or pointed leaves, which in some species are very large. The sepals are nearly equal, sometimes forming a tube at the base and sometimes separate, but generally spreading at the sides.

The chief flower characteristic is the long spur (Plate XII.) which hangs from under the drooping, spreading lip. This lip is often cut or lobed or fringed, and brightly coloured and marked. By examining it one can get a clue to the species, for it seems to be the most variant feature.

The position of the pollen masses is extremely interesting. The coarse pollen granules are packed together and shaped

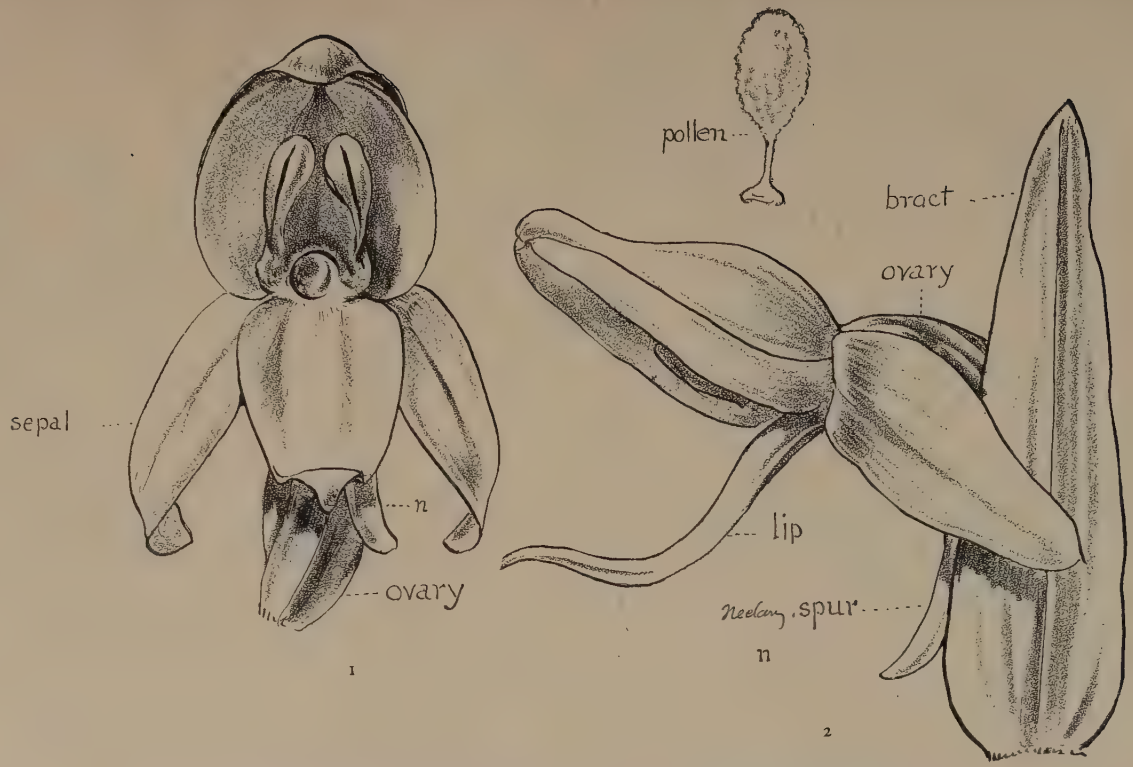
like clubs and lie in parallel anther sacs under the overarching roof of the rostellum. At the base of the clubs are little drum-like sticky discs that are so attached that the pair face each other just the width of an insect's head apart. The observations that Darwin made in some of the English species of Habenaria have been confirmed and illustrated in the blossoms of *Habenaria orbiculata*.

Mr. Gibson says: "In our own native orchids we have a remarkable example of the latter form in the *Habenaria orbiculata*, Large Round-leafed Orchis, whose structure and mechanism have also been admirably described by Asa Gray."

A single blossom of the species is shown in Plate XII., Fig. 1. "The opening to the nectary is seen just below the stigmatic surface, the nectary (*n*) itself being nearly two inches in length. The pollen is in two club-like bodies, each hidden within a fissured pouch on either side of the stigma, and coming to the surface at the base in their opposing sticky discs as shown. Many of the groups of Habenaria or Platanthera, to which this flower belongs, are similarly planned. But mark the peculiarly logical association of the parts here exhibited. The nectary implies a welcome to a tongue two inches long, and will reward no other. This clearly shuts out the bees, butterflies and smaller moths. What insect, then, is here implied? The sphinx-moth again, one of the lesser of the group. A larger individual might sip the nectar, it is true, but its longer tongue would reach the base of the tube without effecting the slightest

contact with the pollen, which is of course the desideratum here embodied, and which has reference to a tongue corresponding to the length of the nectary. There are many of these smaller sphinxes. Let us suppose one to be hovering at the blossom's throat. Its slender capillary tongue enters the opening. Ere it can reach the sweets the insect's head must be forced well into the throat of the blossom, where we now observe a most remarkable special provision, the space between the two pollen discs being exactly adjusted to the diameter of the insect's head. What follows this entrance of the moth is plainly evident. As the insect sips, the sticky discs are brought in contact with the moth's eyes, to which they adhere, and by which they are withdrawn from their pouches as the moth departs. At this time they are in the upright position, but in a few seconds bend determinedly downward and slightly toward each other. This change takes place as the moth is flitting from flower to flower. When the moth with its tongue enters the nectary of a subsequent blossom, by the new position of the pollen clubs they are forced directly against the stigma. This surface is viscid, and as the insect leaves the blossom retains the grains in contact, which in turn withdraw others from the mass by means of the cobwebby threads by which the pollen grains are continuously attached. Thus after the moth's visit the stigma is covered with pollen and the flower cross fertilised.

"In effecting the cross fertilisation of one of the younger flowers its eyes are again brought in contact with this second




XII. Type of Habenaria Blossoms Taken from Tall Leafy Green Orchis

Fig. 1. Front view, looking into throat of blossom. Fig. 2. Side view, showing curved hanging lip and spur.

XIII

Fig. 1. Large Round-leaved Orchis. Fig. 2. Flower slightly enlarged.

pair of discs, and these, with their pollen clubs, are in turn withdrawn, at length perhaps resulting in such a plastering of the insect's eyes as might seriously impair its vision, were it not fortunately of the compound sort."

Of the four hundred species of Habenaria that grow all over the world eighteen are found in our Northeastern States, and about twenty more in the southern and western parts of North America.

The species may be distinguished from each other by the arrangement of the leaves on the stem, by the shape and length of the spur, and by the cutting, fringing of the lip, and by the colour of the blossoms in the mass.

KEY TO SPECIES OF HABENARIA

| | |
|---|---|
| Two leaves rising from the base of the flower stalk. | |
| Flower stalk with bracts. | 1. Large Round-leaved Orchis. |
| Flower stalk without bracts. | 2. Hooker's Orchis. |
| A single leaf rising from the base of the flower stalk. | 3. Small Northern Bog Orchis. |
| Leaves several or numerous. | |
| Lip entire, not parted or fringed. | |
| Ovary straight, an exception to the characteristic twisted ovary. | 4. Small Southern White Orchis. |
| Ovary twisted, flowers greenish yellow, lip lanceolate. | 5. Tall Leafy Green Orchis. |
| Flowers white, lip broad at base. | 6. Tall White Bog Orchis. |
| Lip with a wavy or toothed margin, flowers orange yellow. | 7. Small Southern Yellow Orchis. |

Lip with two or three distinct teeth.

Spur-like sac shorter than the ovary, long bracts beneath the flowers. — 8. Long-bracted Orchis.

Spur slender, curved, longer than the ovary. — 9. Small Green Wood Orchis.

Lip with a tooth on each side of base, and a tubercle at the middle. — 10. Tubercled Orchis.

Lip deeply fringed.

Spur half as long as ovary, flowers yellow. — 11. Crested Yellow Orchis.

Spur longer than ovary,

Flowers bright yellow. — 12. Yellow Fringed Orchis.

Flowers white. — 13. White Fringed Orchis.

Lip three-parted.

Segments of lip narrow, deep fringe of a few threads, flowers greenish yellow. — 14. Ragged Orchis.

Segments of lip broad, fan-shaped and fringed to the middle, flowers white. — 15. Prairie White Fringed Orchis.

Segments fringed about one-third or less, flowers lilac.

Large, showy raceme, lip from half an inch to an inch broad. — 16. Large Purple Fringed Orchis.

Smaller, and more slender wand, lip quarter to half an inch broad. — 17. Smaller Purple Fringed Orchis.

Segments of the lip cut-toothed, flowers violet purple. — 18. Fringeless Purple Orchis.

### I. LARGE ROUND-LEAVED ORCHIS

*Habenaria orbiculata* (Pursh) Torr. (Plate XIII.)

THERE is perhaps no other orchid that so clearly and emphatically makes its presence known in season and out as the Large Round-leaved Orchis. In wandering through the hemlock shades of a wooded hill, or where scant underbrush in rich woods permits glimpses of the forest carpet, one knows it by the two large, round, shining green leaves. Whether the stout, bracted, flowering scape rises between them or not, one can be sure of this orchis merely by the leaves, for they are silvery beneath. Their average is four to seven inches in diameter, though specimens of nine inches have been reported.

Mr. Gibson writes of it: "All orchid hunters know this most exceptional example of our local flora, and the thrill of delight experienced when one first encounters it in the mountain wilderness is an event to date from—its two great glistening fluted leaves, sometimes as large as a dinner plate, spreading flat upon the mould and surmounted by the slender leafless stalk with its terminal loose raceme of grayish-white bloom."

The distinctive feature of the loose raceme is that its many flowers flutter off from the stem, hanging on pedicles that are nearly half an inch long, and having a long spur, much longer than the ovary hanging beneath the lip.

Although this orchid is not showy, it is conspicuous, for it grows from one to two feet in height, and has a sturdy look

about its pale green-white flowers, which is increased by the fact that those which have gone to seed stand stiffly erect. It grows all over the middle of the continent, from Newfoundland to British Columbia, and from North Carolina to Minnesota. In the mountains of Virginia it climbs to the height of 4,500 feet.

Though the blossoms are not very prominent by day, they are pale enough to show white in the dark, as do many greenish-white flowers growing in shady places; and they are visited by the butterflies and moths that fly after sunset, in that beautiful time when the "Night Watch" of the woodland is silently taking the place of the sleepy chirping birds, and the gay flitting insects of the sunshine.

The honey that these night visitors seek is deep in the long spur which measures an inch to an inch and a half in length.

Both the Large Round-leaved Orchis and its smaller relative, Hooker's Orchid, which is next described, have their pollen masses arranged so as to crowd against the eye of an insect visitor, who, by reason of the little beak on the stigma, which may be seen in the illustration of Hooker's Orchid, must push into the opening of the nectar cup as best he can.

### 2. HOOKER'S ORCHID

*Habenaria Hookeriana*, A. Gray. (Plate XIV.)

HOOKER'S ORCHID is one of the earliest of our native orchids to appear in the spring. It grows in the same

localities and at about the same time as *Orchis spectabilis*.

It rises like *Habenaria orbiculata* from two thick shining leaves that do not, however, lie flat on the ground, but rise slightly. They are round or oval, three to five and a half inches long, and sharply, smoothly veined. The whole plant is small, from eight to fifteen inches high, and half that length is taken up by the loose many-flowered raceme of yellowish-green flowers. The flowers have tiny, sharp, spreading green sepals, very narrow petals, and a narrow, sharp-pointed lip less than half an inch long. The spur is also slender and sharp and as long or longer than the ovary.

*Habenaria Hookeriana* is a midland plant, growing from June to September, from Nova Scotia to Minnesota, and as far south as New Jersey, Pennsylvania and Iowa.

There is an English orchid, *Habenaria chlorantha*, that closely resembles this orchid in its structure, and what Darwin has observed concerning the plant familiar to him, we have found true of Hooker's Orchid.

"*Habenaria chlorantha* depends for its fertilisation," says Darwin, "on the larger nocturnal Lepidopteræ. The anther cells are separated by a wide space of connective membrane, and the pollen masses are enclosed in a backward sloping direction. The inside discs front each other and stand in advance of the stigmatic surface. Each disc is circular and in the early bud consists of a mass of cells, of which the exterior layers resolve themselves into matter

which remains adhesive for at least twenty-four hours after the pollen mass has been removed."

The structure of these discs is the same in Hooker's Orchid as in *Habenaria chlorantha*. The stalk of the pollen mass is not attached to the disc directly, but is connected with a little drum-like hinge to which it is fastened at right angles (Plate XIV., Fig. 3). An insect pushing his head between these sticky discs is apt to carry off one or both of the pollen masses, which at first almost stand erect on his head like a pair of horns, and seem, when he enters another flower, to be in danger of hitting against the anther sacs or the discs, and never reaching the stigma. But peep, if you can, at this drum-like hinge under a microscope and you will see a pretty bit of mechanism. The drum contracts or shrinks on the inner under side and pulls the pollen masses down and forward, so that by the end of a few seconds, when the insect is ready to enter another flower, the pollen masses are in the right position to come in contact with the stigma.

Professor Gray said that he had seen a butterfly in Canada that had a pollen mass of *Habenaria Hookeriana* attached to each eye, but as a rule unless a large insect enters this orchid its head is hardly large enough to squeeze between the two discs. But this slight difficulty is overcome by the fact that the lip is curved upward instead of hanging down, and the stigma has a sharp central prominence, so that the flower has the appearance of being divided in half and the insect is generally obliged to approach the nectary in a side-

XIV

Fig. 1. Hooker's Orchis. Fig. 2. Portion of blossom, showing entrance to throat between discs. Fig. 3. Pollinia attached to drum-like disc.

XV. Small Northern Bog Orchis

Fig. 1. Plant about two-thirds its natural size. Fig. 2. Single blossom, very much enlarged. Fig. 3. Pollinium. Fig. 4. Spur cut open.

way fashion, and is sure to get at least one pollen mass on the side of his head.

### 3. SMALL NORTHERN BOG ORCHIS

*Habenaria obtusata* (Pursh) Richards. (Plate XV.)

SIDE by side with the two more striking round-leaved orchis comes one related to them in structure, but so different in appearance and habitat as to appear a very distant relation. It is a tiny green and white plant, commonly known as the Dwarf Orchis, growing in cold, wet, mountainous places. It is found in the Green Mountains from the last of June on through July, and in the White Mountains as late as August. Although it is not very common, yet it is found growing in wet places throughout the states north of Lake Superior, and also in Colorado.

The accompanying illustrations are so full in the enlargement of their detail that they give but a faint idea how tiny the flower is. The whole plant is but a few, at most ten, inches high. The single basal leaf is often not more than two, never more than five, inches in length, and barely an inch wide. The loose-flowered spike is from one to two and a half inches long and the flowers do not measure half an inch, and yet the arrangement for the reception of insects is peculiarly careful, and the wide distribution of the orchid along the wet places of the Northern States shows that it has not suffered extermination for lack of fertilisation.

The anther sacs are widely separated below (Plate XV.,

Fig. 2), probably to leave room in so small a flower for the insect's head, while beneath them on the lip going into the mouth of the spur (Fig. 4), (which in his illustration Mr. Gibson has shown cut open) there run two ridges which converge and make a two-lobed ridge. This doubtless serves to swerve the insect's tongue in such a way that he must turn his head to receive the disc on one side or the other and pull out at least one pollen mass (Fig. 3).

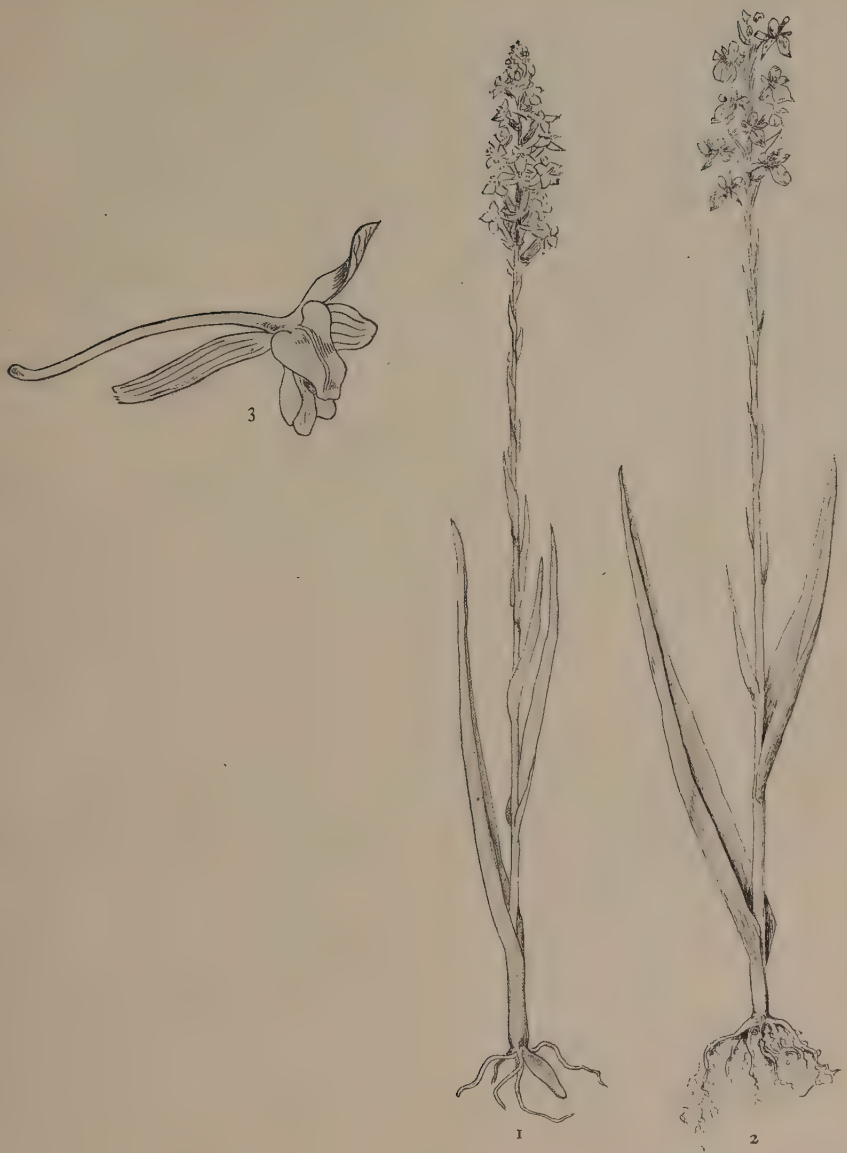
### 4. SOUTHERN SMALL WHITE ORCHIS

*Habenaria nivea* (Nutt.) Spreng. (Plate XVI., Fig. 1.)

THE striking thing about the Small White Orchis of the South is its fine, thin, twisted stem angled with a host of small bract-like leaves pressed closely to it and one long ribbon that flutters from near the base. Sometimes there is a gradation between the long grass-like basal leaf and the others; but generally the contrast is sharp, and the lowest one is four to eight inches long and the upper so small that they merge into the bracts of the spike.

The general appearance of the stem is rather naked, as it appears to have but one leaf—and that like a whip-lash—in its twelve to fifteen inches of height. It bears a loose wand two to four inches long, with many small white blossoms.

An interesting, unexplained and, indeed, unique characteristic of these apparently unremarkable flowers is the presence of a straight ovary. With a magnifying glass, peering into the maze of spurs and bracts in the spike, one




XVI

Fig. 1. Southern Small White Orchis. Fig. 2. Southern Small Yellow Orchis. Fig. 3. Single blossom of Southern Small White Orchis, showing straight ovary.

XVII

Fig. 1. Tall Leafy Green Orchis. Fig. 2. Tall White Bog Orchis.

will see that the ribs of the ovaries are straight instead of being twisted around as they are in every other orchid we have described. This brings the lip on the top of the blossom and causes the long and rather straight and slender spur to hang from above, instead of from beneath the flower.

Why should this species have the stem so strangely twisted and the ovary so straight? How do the insects accommodate themselves to this spur that arches in the air instead of swinging from under the lip? The questions are hard to answer, for the orchid is rare to find, since it is a denizen of the pine barren bogs from Delaware to Florida and almost as shy as its Southern yellow mate, *Habenaria integra*.*

Whoever will find it and spend a week of days in rubber boots watching its winged guests come and go, to see whether they stand on their heads to enter and whether they fly away pollen laden, may solve a mystery that dates back to prehistoric days. Perhaps there are some odd manners left over from the Tertiary age, when plants that are now found only in fossil form on the pine barrens were the progenitors of the modern orchid. Possibly the straight ovary is a relic of an earlier simpler form of orchid, and the twisted ovary a concession to the manners of insects of later days, and possibly it is because the insects are not well adapted to the overarching spur, that the plant is so rare.

*Dr. Britton of the New York Botanical Garden says that he has gathered it but once, and that it was an exquisite and graceful little thing. Dr. Rydberg, an authority on orchids, says regretfully that he has never gathered it, and even pressed specimens are rare.

### 5. TALL LEAFY GREEN ORCHIS

*Habenaria hyperborea* (L.) R. Br. (Plate XVII., Fig. 1.)

We come now to a group of orchids with strong leafy green stems. The leaves ascend the stalk, clasping or half sheathing it, and at the summit is a close raceme of pale flowers.

Perhaps the two species of the Habenaria group that are the hardest to distinguish one from another are the Tall Leafy Green Orchis and the Tall White Bog Orchis. A great many botanists have considered them varieties of the same species, and Asa Gray says that he was tempted to come to the same conclusion, but on close examination he found besides other characteristics, of which the chief is the column, a remarkable physiological difference, viz., that the Tall White Bog Orchis depended on insects for its fertilisation, while in the Tall Leafy Green Orchis the pollen masses commonly fall out of the anther cells while the flower is very young or in bud, and the stigma is thus generally self fertilised.

The descriptions of these two species read almost like duplicate sentences. One must notice the differences in degree and remember that the Tall Leafy Green Orchis is stouter and larger and that the average measurements of each must be taken into consideration all through the species.

The Tall Leafy Green Orchis grows from eight inches to three feet in height. Its leaves are sharp-pointed and

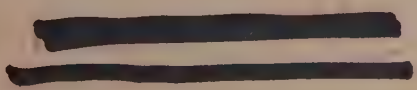
narrow, and from two to twelve inches long and from half an inch to an inch and a half in width.

The spike is narrow, from three to eight inches in length, and the flowers are *greenish* or *greenish yellow*. This is perhaps the sign by which the species can be most readily distinguished, but it is one that botanists never permit themselves to trust; for nearly every plant has albino freaks, and that alone would not be sufficient to split those two closely resembling orchids into two species.

The sepals and petals of the Tall Leafy Green Orchis are ovate and obtuse and about a quarter of an inch long. The upper petals curve over the tips of the two side petals in a little hood. The lip, which is about the same length as the sepals, is lanceolate, entire, with a rounded point at the tip. The spur is also about a quarter of an inch long, and is slightly incurved. Leafy bracts a little larger than the flowers rise from the base of each slightly twisted ovary.

With a magnifying glass one can raise these small flowers to the dimensions of Mr. Gibson's drawings of the Tall White Bog Orchis (Plate XVIII., Figs. 1 and 2), which they closely resemble.

Their stalks are slender and weak, and as the anther sacs are slightly divergent and somewhat overhanging from the curvature of the flower, the pollen masses are apt to fall out of them. On opening buds of this orchis, one will often find that the pollen masses have fallen over and are



lying against the surface of the stigma. Yet their oval discs still retain their stickiness, and as they are placed in the same position relative to the mouth of the spur as in other Habenarias, a visiting insect is apt to draw off a part of the pollen mass from its position on the stigma and to transfer it to another flower. In such a case the flower gets the benefit of cross fertilisation as well as self fertilisation.

Darwin and Asa Gray, who corresponded with each other in this curious exception to the usual rule of cross fertilisation, could not tell whether the Tall Leafy Green Orchis bore its full complement of seeds or not. This is an opportunity for further observation, as well as for meditating in the company of scientists and philosophers on the question as to what economic force has so affected these orchids that with every contrivance at hand for cross fertilisation, they nevertheless persist in trying to fertilise themselves.

Possibly because of the plant's arctic tendencies, it has not always been able to attract insects to its hyperborean latitudes. It is reported as far north as Alaska, and is known in Greenland and Iceland. Could it have been forced to fertilise itself in those cold regions, and have perpetuated the tendency in warmer climes? It grows as far south as New Jersey, Colorado and Oregon, but where the country is mountainous it climbs high, 6,000 and even 8,000 feet. It blooms from May to August, according to its latitude and altitude.

### 6. TALL WHITE BOG ORCHIS

*Habenaria dilatata* (Pursh) Hook. (Plates XVII., Fig. 2, and XVIII.)

THE Tall White Bog Orchis, or Northern Orchis, as Baldwin calls it, is doubtless, he says, "associated in many a mind with a Maine carry, a White Mountain flume, or a Green Mountain notch. Perhaps," he adds, "you recall the very spot, a green nook near the limpid pool in which you dipped your hands; or it may have been higher up, where white-throated sparrows were whistling through the mist, and icy springs came trickling through beds of moss and snowberry, and the bleak summit was almost gained.

"This orchis is one of the most stately children of the forest, and her velvety spike, springing out of rank sedges and ferns, catches the eye at once, or where the plant grows profusely, so perfumes the air as to need no other sign of its presence."

So many have thought it a less luxuriant form of the preceding species, the Tall Leafy Green Orchis, that it has been stated that the flowers are white in the open and green in the woods; but this species holds its colour pretty steadily. It is a pure white, though occasionally plants have been found with a spike tinged with pink or purple.

The leafy stem is more slender and taller than in the Tall Leafy Green Orchis. It grows from one to two feet in height and its sheathing leaves are narrower, less than an inch in width and from two to ten inches long. The sharp

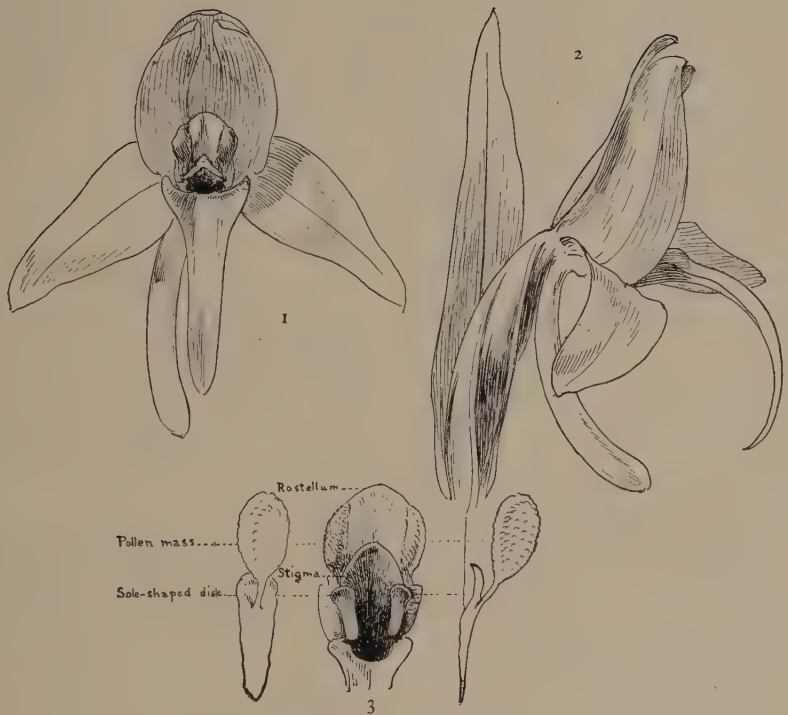
bracts that grow at the base of the ovaries are longer than they are at the lower part of the wand-like spike, but shorter above.

The small white flowers (Plate XVIII., Figs. 1 and 2) are shaped as to sepals and petals exactly like the small green ones of its closely resembling species. But they are fewer than in the spike of the Tall Leafy Green Orchis, and the throat is not so open nor the lip so spreading. The pollen masses lie in parallel anther sacs and are attached by filaments to two discs that are shaped very much like a pair of human soles (Fig. 3). Between the anther sacs is the stigma, with a trowel-shaped rostellum curving over it.

The throat of the flower is a narrow chamber, and the sole-shaped discs and stigma lie so close within that if an insect thrusts its proboscis in, it cannot avoid getting one of these sticking discs on its cheek. The little stems that attach the pollen masses to the discs are very short and flat, and do not, as far as Asa Gray observed, bend down on being withdrawn. In fact they seem already to be bent into such a position that they will touch the stigma of another flower as soon as the bee enters it.

Sometimes the anther cell opens early, as they do in the preceding species, and the pollen masses fall out; but as far as could be seen, they never could fall on the under surface of their own stigma, consequently this plant must depend upon insects to fertilise it.

This orchis lives in cold, wet places and is found in the mountains of New Hampshire at the height of 5,000 feet




XVIII. Tall White Bog Orchis

Fig. 1. Front view of blossom. Fig. 2. Side view. Fig. 3. Anther with pollinia in place, and magnification of sole-shaped disc attached to pollinia.

XIX

**Fig. 1.** Long-bracted Orchis. **Fig. 2.** Blossom enlarged.

and in Nevada at 8,000 feet. It ranges from Nova Scotia to Alaska and from Maine and New York to Utah and Oregon. It blooms from June to September.

### 7. SMALL SOUTHERN YELLOW ORCHID

*Habenaria integra* (Nutt.) Spreng. (Plate XVII., Fig. 2.)

THE Small Southern Yellow Orchid is not so small and delicate a thing as its name implies. It is a rather strong, stout, smooth plant growing from one to two feet in height and bearing a dense spike one to three inches long of small orange-yellow blossoms.

It is not a common orchid, as it has the inherited idiosyncrasy of forgotten ages that makes it prefer the wet pine barrens of the coast to the richer soil of the inland forests. It has been collected in swamps in the pine barrens in Florida and the savannahs near Wilmington, North Carolina, and follows that remnant of a forgotten continent known as the pine barren region as far north as New Jersey.

Its chief characteristic is one to three strong, stout leaves that tend to fold in half as they spring from their clasping bases. The lowest one may be eight inches long, and followed by several that are successively shorter, but often there is but one, about six inches long and one inch broad, which is followed by a small leaf and then seven or eight bracts at intervals of about one inch, along the straight, deep-ribbed stem.

In the flower the upper sepals and petals come together

to form a little hood, while the sepals at the side spread out and are a little longer than the petals. The lip is almost entire, giving the species the name *integra*, which means "whole." It is, however, slightly cut around the margin. It is not large and showy, neither is the straight spur that hangs a trifle longer than the lip remarkable for any peculiar shape. Looking into the heart of a flower with a microscopic eye, one may see a pair of little fleshy horns with the back of the stigma protruding between them.

### 8. LONG-BRACTED ORCHIS

*Habenaria bracteata* (Willd.) R. Br. (Plate XIX.)

ONE would never notice this slight inconspicuous orchis, with its few inches of leafy stem and its tiny closely pressed green flowers, were one not in the mood to "peep and botanise." Even at its maximum height of two feet its blossoms are not attractive to the eye. Compare these minute flowers with narrow thread-like petals, barely a quarter of an inch long, and the strap-like lobed lips and the very short sac-like spur, with the painted glories of the florist or even with some of the beautiful fringed wands of the other native-growing Habenarias, and one wonders that they both are called orchis; and yet a good hand lens will magnify the flower into a very elaborate and exquisitely modelled member of the family. The anther sacs lie side by side, with diverging apertures from which are drawn a pair of club-shaped pollen masses, exactly as in the types that

have been described. It has one familiar and easily recognised characteristic, the long leafy bracts that give it its scientific name. These project much beyond the flowers in the small two to five-inch spike, and are two or three times as long as they are at the base, but grow gradually shorter as they reach the summit.

The Long-bracted Orchis has a wide habitat. It grows in woods and meadows from New Brunswick to British Columbia and from North Carolina to Nebraska. It climbs the mountains as high as 3,600 feet in Virginia and seems as much at home in Europe as America. It therefore possesses some secret of attraction for insects—some microscopic charm of night odour, or some hint of hidden nectar that invites tiny insects to its portal to bear away their infinitesimal clubs of pollen, and thus keep the species widely spread.

### 9. SMALL GREEN WOOD ORCHIS

*Habenaria clavellata* (Michx.) Sprengel. (Plate XX.)

In the warm summer weather in July and August the Small Green Wood Orchis blooms in wet woods all over the eastern portion of the American continent from Newfoundland and Minnesota to Florida. It has been found as early as June 6th along pine wood streams in Louisiana, and as late as August 28th in Tennessee, and September 2d on the shores of Pyramid Lake in northern New York. It grows on the sea-bound island of Martha's Vineyard, and at

an altitude of 6,000 feet in North Carolina and of 2,500 feet in the Green Mountains. It is a common orchid and one that is easily recognised by its very slender-angled grass-like stem and its single long, broad leaf that clasps the stem about one-quarter of the distance from its thick, fibrous root. This large base leaf, which is usually four or five inches long and an inch broad, is followed by a small lance-shaped leaf that clasps the stem a little higher up; and then come three or four tiny bract-like leaves, and finally the loose spike, not more than two inches long, of small greenish-white flowers. The whole plant does not exceed eighteen inches in height, and is generally about a foot high.

The spikes are loose and small, about two inches long, and having ten to twelve half-inch blossoms, though often there are but five or six. Below each flower grows a tiny leaf-like bract that is shorter than its twisted ribbed ovary, and curving beneath each lip is a long, slender spur. The lip is the distinguishing feature of this species, as it broadens at the apex and is three-toothed.

The name *clavellata* means "little club," and refers to the club-shaped spur. The orchid was formerly called *tridentata*, possibly because its lip was three-notched, but more probably because of three teeth or knobs or horns that appear on the stigma. One lies outside each anther cell and one between the cells. These may be, according to Gray, who described them, sterile stamens. He notes that they are sticky on their surfaces, and the spontaneously detached grains of pollen stick fast to them and "send

XX

Fig. 1. Small Green Wood Orchis. Fig. 2. Single flower enlarged.

XXI

Fig. 1. Tubercled Orchis. Fig. 2. Single flower enlarged.

down pollen tubes freely into their substance, so that they appear to act as stigmas, though the normal stigma is found in its proper place and of ordinary appearance underneath the discs." This real stigma does not seem as sticky as these little clubs; but it does not seem possible that this promiscuous and apparently careless breaking off of the pollen masses and the sticky horns that are above the stigma can have anything to do with the fertilisation of the plant, for when the discs at the base of the stalks of the pollen masses are touched the entire mass is removed and the stalks bend down in the typical way under the weight of the masses.

This orchid has the peculiar habit of being ready for its visitors several days before the blossoms open. At least four or five days before the folded petals part the pollen is ripe and the anther cells are open, and there appears to be danger of the pollen falling out. And yet in peering into the flowers that are freshly opened, one sees that fragments which fall from the pollen masses could not fall on the stigmatic surfaces of the same flower, for the blossom when it first opens is horizontal and any detached fragments would fall on either side. It must then depend on insects as the others do.

### 10. TUBERCLED ORCHIS. SMALL PALE-GREEN ORCHIS

*Habenaria flava* (L.) A. Gray. (Plate XXI.)

If the name Small Green Orchis serves to make a distinction in the mind between the other large green orchis,

such as the Round-leafed and Hooker's Orchis, then one must learn to separate this from the preceding one by noticing that the Tubercled Orchis has a leafy stem, and that the Small Green Wood Orchis has only a single leaf at its base and bracts the rest of the way up the stem. Another distinguishing feature is that the spur in this one is short and does not swing down under its twisted ovary like a crescent moon, as in the one just described.

Having noticed these characteristic differences, one may dwell upon the general features. The stem is rather stout, and at most two feet high. The leaves that crowd upon it are elliptical or lance shaped, and may or may not be sharp-pointed. They are sometimes a foot long, but usually about half that length. The spike of flowers is about the length of a finger, though it may grow to six inches, and the little sharp green bracts bristle out between the small greenish-yellow flowers.

The characteristic that gives this plant its name is a little tubercle that lies in the middle of the lip, at its base, just as it hangs off below the anther sacs (Plate XXI., Fig. 2). It does not seem to have any particular economic function, and yet possibly nothing has been said about its value, because no one has watched it entertaining its insect friends. Whatever may be its function, it is faithfully produced on the lip of each plant, whether it be found in a wet meadow in Ontario or Minnesota, or in Florida or Louisiana. Some progenitor in bygone ages originated this little tubercle, and with the faithfulness with which

beetles reproduce their markings and caterpillars their knobs, this inconspicuous Small Pale-green Orchis has perpetuated its tubercle to this day.

### II. CRESTED YELLOW ORCHIS

*Habenaria cristata* (Michx.) R. Br. (Plate XXII.)

THERE are two yellow orchids with fringed petals, *H. cristata* and *H. ciliaris*. They look much alike in word descriptions, but when one has the flower of either to examine, two glances will decide the species; a first one at the thickness of the long spike of blossoms, *H. cristata* being one to one and a half inches in diameter and *H. ciliaris* nearly or quite three inches across; and a second glance at the kind of fringe on the lip, *H. cristata* has the loose fringed part deeper than the unfringed portion of the lip, and *H. ciliaris* has a long oblong lip deeply fringed all the way around.

*Habenaria cristata* is the more southern of the two. It grows chiefly in bogs from New Jersey to Florida and Louisiana, becoming more plentiful as it gets further south. It is a slender leafy-stemmed plant, growing from eight inches to two feet in height, with two or three lanceolate leaves two to eight inches long clasping the angled stem at intervals on its lower half, and on its upper half a number of small sharply pointed leaved that pass into the flower bracts of the spike.

The spike is two to four inches long. Its bright orange

flowers are the same length as the bracts that grow beneath them. The flower itself is not very large, perhaps a half to three-quarters of an inch, including the slender twisted ovary. The sepals are roundish-ovate, and those at the side spread apart. The two small upper petals and the lip are fringed like the teeth of a comb, through more than half their length. The spur is shorter than the lip, and less conspicuous in this species than in *Habenaria ciliaris*. It blossoms from July to August.

### 12. YELLOW FRINGED ORCHIS

*Habenaria ciliaris* (L.) R. Br. (Plate XXIII.)

Mr. Henry Baldwin, the orchid lover of New England, has said that this orchid should be called "Flaming Orchis," "a fit symbol of the wealth and glow of August; resplendent in orange and gold, not only in sepals and petals, but even in spurs and ovaries, and admitting but one rival, the Cardinal Flower, burning its torch well into September in northern New England."

It is delightful to note that this orchid is not rare. There is a bog near Plymouth, Mass., where it is said to be "almost a weed," and there are places near New York where it is gathered by the ruthless in armfuls. The Northern woods, whose flowers are often so inconspicuous compared with those of the South, glory in this orchid, for in many a ferny meadow, or open bog, or the wet banks of a brook, all the way from New England to Minnesota, and south to Florida and

XXII. Crested Yellow Orchis

XXIII

Fig. 1. Yellow Fringed Orchis. Figs. 2 and 3. Flower of Yellow Fringed Orchis, much enlarged.

Louisiana, these blossoming rods of gold rise fringed and feathered among the tall grasses of July and August.

The Yellow Fringed Orchis is one of the tallest and stoutest of all our orchids. It often grows two and a half to three feet tall, and has long narrow leaves with sharp points that may measure twelve inches, but that generally are four to eight inches long. These are large at the base, but after the first two or three dwindle abruptly into bract-like leaves, that give the stem the appearance of being naked for a foot or more of its length. At the summit bursts forth this mass of golden fringe, in a spike of blossoms three to six inches long and often three inches thick.

The individual flowers are orange or yellow, large and showy. The sepals are rounded and broader than they are long, and spread like ears at either side of the lip, while the third one is hooded over the column. The two upper petals are very narrow and generally toothed, and are almost hidden under the hooded sepal. The long lip, with its deep fringe, must offer a dazzling threshold to passing insects, who find awaiting them the opening to the long, slender spur that contains the nectar.

As an insect alights at the bottom of the stalk to visit the first blossom, his weight bends the long lip down to such a degree that he would slip off were it not for the dense fringe to which he seems to cling as he clambers up, shaking the whole spike as he goes. But arriving at the opening of the spur that holds the nectar in the tip of its long, slender tube, he unfurls his tongue and sucks. The meanwhile his head

is pushed into a narrow aperture between two sticky discs, to which are attached the stalks that bear the pollen masses. They lie nearly horizontal, diverging at the disc end. The stalks are two or three times as long as the pollen masses which they bear.

Which are the particular insect visitors that flutter around this torch of the meadows, no Darwin has yet recorded. It is a bit of observation that any one might make who has long summer leisure to haunt a bog or brook by which the Yellow Crested Orchis grows. The data are all at hand in the blossom itself. The space between the discs is about one and a half lines wide, so that an insect must have a head about the same width if he would press against them and on backing out draw forth the pollen masses. The spur is from an inch to an inch and a half in length, and is very slender, so the insect's tongue must be about an inch long if he would be sure of reaching the nectar.

To prove the fact that the insects do visit it, it is only necessary to count the seed capsules at the end of the summer. But the act, the presence of the winged desire, the actual entrance of the butterfly or moth into the fringed portal, the flying off with the pollen masses sticking by their discs to his eyes and bending forward by their own weight, and his entry to another where they will strike again the viscid stigma just under the column, and send the thrill of creation down the narrow twisted ovary to quicken the waiting ovules—this is a mystery with a key—that needs only time

and patience and watchful eyes. It may be solved by you or me. And certainly no more attractive subject of study could be found than to watch the life habits of this Yellow Crested Orchis, with its amber horns dripping with nectar and its fringed banners fluttering to the breeze.

### 13. THE WHITE FRINGED ORCHIS

*Habenaria blephariglottis* (Willd.) Torrey. (Plate XXIV.)

THE White Fringed Orchis is apparently an albino sister of the Yellow Fringed Orchis, and yet it has distinctive characteristics that make it a constant species. Although a description of the White, save in colour words, sounds exactly like a description of the Yellow, yet side by side the White Fringed Orchis is always a little smaller and a little less robust. Its pure white flowers are smaller, its oblong fringed lip is narrower, and the fringe is seldom as thick as on the lip of the Yellow Orchis. These two orchids frequently grow side by side in the same swamp, and that the bees and insects are indiscriminate match makers is very evident from the fact that in marshes where both grow together there will be found a hybrid form with pale yellow blossoms.

*Blephariglottis* is the name that has recently been adopted by some authors for the fringed orchids—those that were the most eagerly sought and the best known in the large old-named group of Habenaria. To a Greek child in the woods of Hellas, did any of these fringed orchis

grow there, the name would be a perfectly simple and appropriate nickname. *Blepharon* means "beard" or "fringe," and *glottis* "throat," and the combination *Blephariglottis* is the equivalent of our adjectives "fringed" or "crested throat." It is, however, not the throat, but the petals and the hanging lip that are fringed or cut or cleft. These give a peculiarly starry effect to the flowers, which grow in tall, strong open spikes, with space enough between the individual blossoms to let each petal hang its delicate fringe to the breeze.

These loose but most symmetrically arranged spikes, tapering to a point at the budding end, are among the loveliest floral wands that grow. The first effect is of a delicate silky fringed maze forming a spike of lavender, yellow or white, but looking closely into it one sees that its charm lies in the beauty of the grouping of the flowers on the stalk. Each flower has a very slender twisted ovary, that curves away from the stalk at such an angle as to hang the fringe petals on the outside of the spike wand. The base of each ovary is sheathed by a delicate sharp-pointed leaf bract that is sometimes long enough to protrude its bright green tip between the fringes of the circling blossoms. From the base of the twisted lip there swings a long spur curved like a scimitar, and hanging longer than the lip itself. Down in the depths of its wax-like white or gold or lavender tube is the nectar well that the long-tongued insect seeks, and to reach which he must strive strenuously and press against the sticky discs of the pollen masses. The anther sacs in this genus are widely separated and diverge from one

another so that there is a space wide enough between the discs of the pollen masses for the broad head of a bumblebee.

Gray says that these two closely allied orchids are "chiefly remarkable for having their viscid discs projecting much more even than in *Habenaria orbiculata*, the anterior part of the anther cell and the supporting arm of the stigma united tapering and lengthened to such a degree that the viscid discs are as if raised on a pedicel, projecting considerably beyond the rest of the column. The anther cells are nearly horizontal, greatly divergent, but inclined somewhat inward at the ends, so that the discs are presented forward and slightly inward, at least in *Habenaria blephariglottis* or in *Habenaria ciliaris* more directly forward. Evidently these projecting discs are to be stuck to the head of some nectar-sucking insect. The stigma, which is rather small, is between the lateral arms, in the same horizontal line with the discs; the discs are small but quite sticky and directly affixed to the extremity of a stalk which, in just proportion to the forward elongation of the anther cell, etc., is remarkably long and slender, twice or thrice the length of the pollen mass it bears. Upon removal, a slight bending or turning of the slender stalk brings the pollen mass into position for reaching the stigma. The discs in ordinary flowers of *Habenaria ciliaris* are about a line and a half apart (the English line is the twelfth part of an inch), the slender spur an inch long, from which somewhat of the structure and size of the insect adapted to the work in hand may be estimated."

### 14. RAGGED ORCHIS

*Habenaria lacera* (Michx.) R. Br. (Plate XXV., Fig. 1.)

THESE fantastically cut and slashed blossoms that make a greenish-yellow maze on the slender stem of their species deserve a better name than Ragged Orchis. The English writer Sweet calls it the Torn-flowered Habenaria, and describes it as being "elegantly jagged" in appearance.

It is a small plant from one to two feet high, bearing leaves that grow smaller as they climb the stem, and a loose spike of flowers from two to six inches long. But the individual flowers—could any one conceive anything more remarkable than the way in which this lip, not more than an inch long, is cut and slashed and divided? First it is parted in three main segments, and these again are divided, and notched and slit, till it is hopeless to follow the law of their fashioning.

Asa Gray thinks that the orchid must be very fascinating to insects, for he says that the pollen masses are generally removed from older flowers and the stigmas fertilised. But Mr. Gibson, in a pencilled note made on this sketch some twenty years ago, when he first began to watch the ways of the orchids, hints that even lesser intelligences than Asa Gray's believed the orchid to be attractive to insects. He writes: "Found also on above, among flowers, a smooth caterpillar, pale green, that had formed a screen of the fringed petals, with meshes of a web exactly counterfeiting the colour and size of the fringe; also a pure white spider

precisely resembling the fringed petals with its long legs." Did the spider not know by experience that it could weave a web to good advantage where the insects come so gladly; and did the caterpillar know by that accumulated experience of his progenitors that constitute instinct that the colour of the orchid's delicately screening fringe matched his own juicy skin and protected him from the birds that might be snapping insects around this attractive shrine? Who can tell? No one, unless he will sit in the woods' secret places and watch and watch until the actual doings of the tiny things are revealed. Could Thoreau have had the eyes and pen of Mr. Gibson he would have suggested philosophies enough to us to even allow insects a theology.

But what the insect does is this. He creeps up the fringe straight to the middle of the blossom, for as Gray says, "The nectary can be approached only from the front, the sides being guarded by a broad, thick shield on each side—the arms of the stigma much developed—above supporting the anther, while its inner and concave face bears the remarkably long and narrow viscid discs. Posteriorly on its upper margin a sort of cellular crest is developed." These discs are in just the right position to receive the pollen masses as they come in borne on the head of an insect, who has been obliged to dive head first straight into the first flower he visited, and who now must enter again in the same way with his burden. Just as in so many other orchids, the pollen masses, as soon as they are withdrawn from the anther above, are depressed into just the right position to

touch the stigma, so in this they lie poised on the bee's head in such a position that as he plunges in to take a drink the pollen masses strike and stick to the stigma.

### 15. PRAIRIE WHITE FRINGED ORCHIS

*Habenaria leucophæa* (Nutt.) A. Gray. (Plate XXV., Fig. 2.)

THE western prairies have a white fringed orchis with fragrant flowers that grows large enough to be almost as beautiful and conspicuous as the yellow and the other white fringed orchis. It is a stout plant with an angled, leafy stem, set with long, clasping, pointed leaves, and it has a very thick, loosely flowered spike of white blossoms. These are sometimes tinged with green. They cannot be mistaken for the other white fringed orchis, for the latter, *Habenaria blephariglottis*, has a long, narrow-spined lip, while the lip of the Prairie White Fringed Orchis spreads like a three-parted, deeply fringed fan. The same long spur, an inch or an inch and a half in length, swings from the lip, as in the Yellow and White Fringed Orchis.

It loves moist prairies and takes its name from the free lands under the open sky in Western New York and the Middle States, where it blooms in July

### 16. LARGE PURPLE FRINGED ORCHIS

*Habenaria grandiflora* (Bigel.) Torrey. (Plate XXV., Figs. 3 and 4.)

THE Large Purple Fringed Orchis is the most regal and glorious of all the fringed orchids. One cannot but sym-

XXIV

Fig. 1. White Fringed Orchis. Figs. 2 and 3. Single blossom, much enlarged.

XXV. Blossoms of Several of the Different Species of the Fringed Orchis, Showing Characteristic Fringing of Lip

Fig. 1. Ragged Orchis. Fig. 2. Prairie White Fringed Orchis. Figs. 3 and 4. Large Purple Fringed Orchis.

pathise with Thoreau, who grumbled because it grew so abundantly in the Maine woods, where only the moose and moose hunters could see it, and so rarely in Concord where philosophers dwelt. It has, however, although freakish in its habits, a wide range, so that its scarceness in certain localities may be due to the ruthlessness with which people who are not philosophers have snatched these long, stately stalks to put in vases. It grows during June and July in rich woods and meadows from New Brunswick and Ontario and Michigan as far south as North Carolina.

It is the tallest and stoutest of all the North American orchids. Its strong stalk, with clasping sheath above the fleshy root, is sometimes half an inch in diameter, and it may grow five feet high, though three or four feet is its average.

Its several large leaves are oval or lanceolate, from four to ten inches long and from one to three inches wide. Baldwin says that he has found them as broad as a man's hand. The stalk is deeply grooved and is beribboned with narrow leaves on its upper half. The magnificent lilac or purple-pink raceme at its summit has fifteen inches as its greatest recorded length, but it averages from three to ten inches, with a diameter of two to three inches and over.

The fragrant fluttering blossoms, with their green pointed bracts and their long spurs, make a loose feathery spike, which, as Baldwin says, "suggests a flock of birds struggling to get foothold on the same branch."

The characteristic sign of the species is the peculiarly

beautiful lip which spreads like a fringed fan, with three divisions. It is from one-half inch to an inch in width. It is grooved down the centre to form a channel that leads directly to the opening of the long, slender spur. Over this opening, and between the small converging petals and sepals, is the column. The relation of the parts to each other may be seen by the diagram.

Gray noticed that the two side divisions of the lip "aid in hindering approach" from those directions, while the middle division offers a convenient landing place in front. The contracted base of the lip is grooved, or with incurved margins, the trough leading as a sure guide to the nectary. The two anther cells are widely separated, but little divergent; their lower ends projecting strongly forward, bring the naked discs just into line with the orifice of the nectary."

If the sharp point of a pencil be thrust between the fringes down the throat of the nectary and be immediately withdrawn, it will be found that in the moment's contact the two sticky discs have adhered to it, and that the pollen masses have been withdrawn from the anther sacs. On holding the pencil still while one slowly counts fifteen or twenty, it will be seen that the pair of slender stalks that hold the pollen masses somewhat erect are slowly depressed, until the pollen masses lie at just the angle that would make them hit against the broad stigma if the pencil were again pointed toward the opening of the spur.

The pedicels of the stalks are like minute drums, smaller than those in Hooker's Orchid, and if one follows the down-

ward movement of these pollen masses with a watchmaker's glass in the eye, it will be possible, perhaps, to see that the little drums contract on one side and that the depression to the proper angle is caused by this mechanical device.

### 17. SMALLER PURPLE FRINGED ORCHIS

*Habenaria psycodes* (L.) A. Gray. (Plate XXVI.)

The Smaller Purple Fringed Orchid is the one that brings the greater delight to flower lovers because it is more readily found. Its long, slender wand of lavender blossoms, fringed like the eyelashes of an houri, are found in meadows and swamps and wet woods all through July and August, from Newfoundland to North Carolina and from New England to Indiana.

It is so like the Large Purple Fringed Orchis in every respect except size, that is has often been taken for the same species, or at least for a smaller variety, but it has its own distinctive characteristics. In the first place it is very slender and fragile in its appearance, and never grows more than three feet high. Its leaves are strong and stout and smooth, with a heavy midrib, but narrower and more lanceolate than those of the Larger Fringed Orchis. They clasp the square purple-mottled stem on the lower half, completely, passing into shorter bract-like leaves above, as in all the other fringed orchids.

The flower raceme is much shorter and narrower than in the Large Purple Fringed Orchis. It is generally two to

four inches in length, but may reach six inches, and is rarely more than an inch and a half thick. The slender twisted ovaries hold the blossoms face outward, with their exquisitely fringed petals rising, tier above tier, in a lavender mist. The incurved bracts and the recurved spurs make a series of airy curves seen through the lilac fringes, and the whole effect is of a paler, more delicately fashioned and lovelier flower than the more splendid Large Purple Fringed Orchis. The inch-measure test is a matter-of-fact one to apply in distinguishing these two fringed orchis from one another, but it never fails, for the three-parted fringed lip is never more than one-third to half an inch wide in the smaller plant, while the lip of the Large Purple Fringed Orchis is three times that size. There is also a trifling difference in the cutting, the segments appearing notched rather than fringed in the smaller, while they are split into anther-like fringes for quite half their length in the Large Purple Fringed Orchis. Twenty years ago Mr. Gibson made for "Highways and Byways" an illustration of the Smaller Purple Fringed Orchis tangled in a spider-web and receiving the visit of a moth, and wrote of it as follows:

"The life history of this flower, as it has been revealed to me through recent observations of my own, is of such absorbing interest that I am tempted into a narrative of my investigations. They were the outcome of an intent perusal of Darwin's wonderful discoveries chronicled in his 'Fertilisation of Orchids.' This book led me with feverish impulse into the conservatory and field. Like many

XXVI. Smaller Purple Fringed Orchis

**Fig. 1.** Stem and basal leaf. Fig. 2. Flower stalk. Fig. 3. Parts of single flower magnified.

XXVII

Fig. 1. Fringeless Purple Orchis. Fig. 2. Characteristic shape of lip.

flowers, this little fringed orchid is constructed on a principle of reciprocity. The insects serve the plant and the plant yields them food in return. Let us examine the structure, which will be readily understood by reference to the diagrams. In this instance the bait consists of the usual sweet secretion, here deposited at the end of a curved tubular nectary, nearly an inch in length. The opening to this nectary is seen directly in the heart of the flower. But observe how that entrance is guarded—defended with two clubs, if I may so speak, the pollen masses bearing some such resemblance. These are hidden in two pockets, one on each side of the opening. The lower extremity of each is provided with a flat, sticky disc, turned inward. This is all very simple. The trap is set. Now let us see how it works. A small brown hawk-moth hovers near; he poises like a humming-bird in front of the blossom, uncoils his slender tongue and thrusts it into the opening of the nectary. So transparent is this tiny tube that you can readily see, not only the tongue within but the gradual absorption of the nectar. As the moth thus sips he brings his tongue in contact with one or both of the sticky discs. They clasp it firmly and, as the member is withdrawn, they are pulled out of their pockets (see Plate XXVI., Fig. 4). This alone is surprising, but what follows is stranger still. In a very few seconds the little club begins to sink forward, gradually lowering, until it has brought itself nearly level with the tongue. Wilted, you will imagine. Not so; it is still firm in its new position. And what will be your surprise, if you

watch closely as the humming rover sips from the next flower, on seeing the tip of that club so tilted, strike directly against the stigma, or fertilising surface, just above the opening of the nectary! The flower is thus fertilised and will mature its seeds.

"The flowers are frequented by several kinds of flying insects, but this little day-flying sphinx is one of the most common insects, and the very conformation of the orchid would indicate, from its slender tube and the distance of the nectar from the orifice, an adaptation to the long, slender tongues of moths and butterflies. I have never happened to see a bee upon this orchid, and I doubt whether the insect could reach the nectar, unless, perhaps, through the external puncture of some bumblebee, which insect has a wellknown trick of cutting matters short and saving itself trouble by biting through the honey tube from the outside.

"These experiments with the orchid may be tried by any one. The drawings herewith given were made from an actual specimen of the insect, which suffered martyrdom in the cause. You may observe the appearance of an insect's tongue after searching a few nectaries. It was interesting also to notice the sagacity of a diminutive spider that seemed to know the attraction of these honey tubes, and had spread its web among the blossoms. Its meshes were sprinkled with minute insects, among which I discovered one rash atom with a club-shaped appendage as large as its body firmly attached to the top of its head."

### 18. FRINGELESS PURPLE ORCHIS

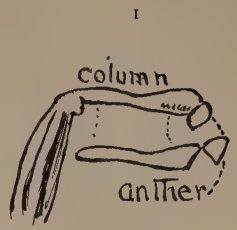
*Habenaria peramoena*, A. Gray. (Plate XXVII.)

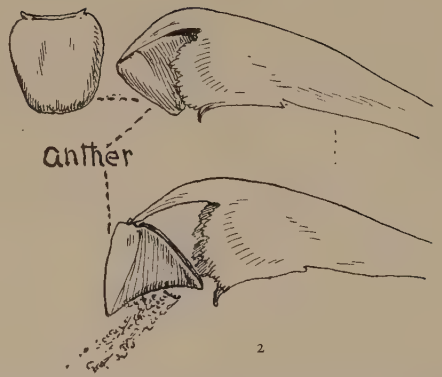
It is sometimes a comfort to the lover of flowers, who vainly seeks to know them by name, to find some one distinctive feature by which he can quickly identify the new flower that has made his walk an experience to be remembered. In the bother of mentally calculating whether a certain specimen of purple-fringed orchis is a large specimen of *H. psycodes*, or a small one of *H. grandiflora*, one is distracted from an enjoyment of its beauty, and is tempted to feel a trifle of impatience at the naming of names, and to wish one were back in the Garden of Eden, where, according to the little boy's version, "Adam called the elephant an elephant because it looked like an elephant."

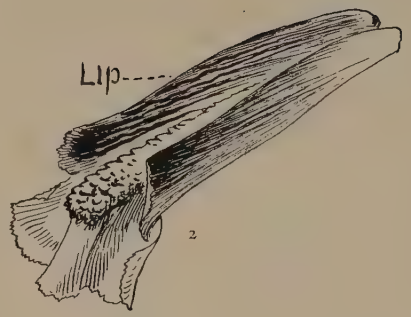
But with the Fringeless Purple Orchis it is different. One knows at once that because it has a long two- to seven-inch spike of purple flowers that are *not* fringed on their wide-spreading, deeply lobed lips, it is *Blephariglottis peramoena*. In every other way it looks like the other two purple Habenarias. Its long lower leaves are elliptical or lanceolate. Its stem is from one to two and a half feet high. Its flowers are violet-purple, arranged in a spike, which is about two inches in diameter. There are sometimes only a few, as in the illustration, but usually when growing in fertile grounds, they are crowded on a long seven-inch spike. This one feature, however, is its own. The fan-shaped

three-parted lip is only a little cut or notched on its edges, and has no fringe.

The inner workings of this orchid are as complex and wonderful as those of its fringed sisters and will prove as interesting to study as they. It grows in moist meadows all over the Eastern States from New Jersey to Virginia and Kentucky, and as far west as Illinois, and blossoms in July and August.




XXVIII

Fig. 1. Blossoms of Rose Pogonia, showing hairy lip, with detail of hinged anther. Fig. 2. Detail of Whorled Pogonia, showing hairy, grooved lip and hinged anther.

XXIX. Rose Pogonia

## IV

## POGONIA

(Plate XXVIII.)

As one plunges into a swamp, still with the heat of June, or into the marshy borders of an Adirondack lake, where a host of shimmering sedges and feathery grasses lure one into the belief that the sphagnum bed is solid earth, there will surely be found, growing with the deep rose-pink blossom of Limodorum (Calopogon), a flower of paler rose, and with a fringed and bearded lip. It is the Rose Pogonia or Snake Mouth. It serves as a type of the Pogonia, a genus of thirty species that are scattered over the world, and five of which grow in North America.

The name is derived from a Greek word meaning a beard, referring to the hairy crest on the lip.

The Pogonias are low, small, grass-like plants rarely growing more than a foot in height, and scantily leaved. As a rule the blossoms grow singly, and are large and showily coloured, poised delicately on the stalk that swings as lightly and securely as the grasses.

The absence of a spur, and the bristly beard of hairs on the gaily tinted and notched or lobed lip is characteristic of the Pogonias as well as of the closely related Arethusa,

but the Pogonias are distinguished by the fact that their sepals and petals are separate, and that the long club-shaped column is free from the lip, while in Arethusa the sepals and petals are joined at the base and the column adheres to the lip.

The anther has two parallel sacs, each containing a mass of powdery pollen grains, to which no stalk is attached (Plate XXVIII., Figs. 1 and 2). Over them is fitted a cap or lid that springs back when an insect presses against it in the right way. The stigma, a flattened disc, lies under the anther. The method by which fertilisation takes place in the Pogonias, as well as in Arethusa, is described by Mr. Gibson on page 79.

The capsule stands erect, and is long and slender and strongly angled.

The Pogonias and the Arethusa, under which latter name they were formerly classed, form a group to stir the imagination of a philosopher, but not while he is trying the staying powers of a sphagnum bed. Before donning rubber boots to seek these marsh-loving plants, it will interest him to know that Darwin made the group *Arethusa* a subject of special study, with reference to their special adaptations to cross fertilisation. It would seem as though with them, as with the maidens of royal families, it was more necessary to make elaborate preparations for a suitor than with the commoner flowers, which like the commoner people, have no fear that their families may die out for want of offspring.

One of the inhabitants of Australia has a curved feathered

lip, which, the moment an insect lights on it, shuts up like a spring against the anthers, carrying the insect into a little prison formed of the petals and a sepal, that arch in a hood over the column. This stays closed for about half an hour, before it opens to set him free, so that whether or not he finds nectar to beguile his stay, he cannot escape until he has become well smeared with pollen to take to the next flower.

The aromatic pod from which vanilla is derived is the fruit of an orchid belonging to this group. It is a native of South America, but is transplanted by growers to foreign countries, where it blooms profusely, secretes plenty of nectar, but never sets the valuable pods, unless the planters deliberately transfer the pollen from one plant to another Either the insects are not adapted in size, or length of tongue, or they do not crawl in and out in just the right way to carry off the pollen, or else they do not care to try the foreign nectar. Possibly the nectar may have the same effect on the unaccustomed insect that was observed when a British bee was formally invited to enter a hothouse orchid from Guatemala that closely resembled the vanilla orchid. He pushed his way in, sipped the nectar, backed out and keeled over on the labellum, where he lay with legs stretched out, as if dead. By-and-by he recovered, but doubtless with sufficient experience to warn him against any further attempt at satisfying his hunger with such intoxicating cordial, and incidentally cross fertilising that particular species of foreign orchid.

Another British cousin that Darwin experimented with plainly shows by its actions that it fears that insect services could not be relied on as completely as some thousands of years gone by, for it has become adapted to fertilise itself. The anther opens while the flower is in bud and pushes the pollen partly out, and then, before there is the slightest chance for an insect to come in, the pollen sends out long tubes toward the stigma that penetrate its tissue and begin to fertilise the ovules. Then the welcome to the insects is extended, purely as a formal courtesy, it would appear, for the pollen mass is balanced in such a way as though it might fall at the slightest touch, exactly on its own stigma.

To Darwin, who was studying the orchids to prove the theory of cross fertilisation against that of self fertilisation, this orchid's vagary seemed a startling exception, especially when he covered four blossoms with a net while they were still in bud, and saw them open, and without the aid of any insect produce capsules that looked as fine as any growing free. But on weighing the seeds of the capsules of the covered plants he found that they weighed more than one-third less than those from an equal number of capsules on uncovered plants. Moreover, under the microscope he discovered that the self-fertilised capsules had seven times as many bad seeds as those that were fertilised by the insects in the garden, proving that cross fertilisation did take place, but that the orchid had prepared itself for self fertilisation in an emergency.

Of the thirty species of Pogonia, widely distributed over the world, only the following five are found in North America:

KEY TO THE SPECIES OF POGONIA

| | |
|---|---|
| Sepals and petals nearly equal and alike. | |
| Lip crested and fringed, flowers rose colour, solitary or in pairs. | 1. Rose Pogonia. |
| Lip not crested, several pale purple flowers on drooping flower stalks. | 2. Nodding Pogonia. |
| Sepals longer and narrower than the petals. | |
| Stem with single leaf near the middle, and bract near the flower; flesh-coloured petals with purple-veined crested lip. | 3. Spreading Pogonia. |
| Stem with whorl of five leaves at the summit. | |
| Sepals one and one-half to two inches long, wide spreading, dark purple. Flower solitary, greenish yellow. | 4. Whorled Pogonia. |
| Sepals only a trifle longer than petals, two or sometimes one flower above whorl of leaves. | 5. Small Whorled Pogonia. |

## 1. ROSE POGONIA, OR SNAKE-MOUTH

*Pogonia ophioglossoides* (L.) Ker. (Plate XXIX.)

THE Rose Pogonia is a slender plant, springing from a fibrous root. It grows about a foot in height, with two or three leaves and a single flower that smells, some say,

like sweet violets. A pencilled note in Mr. Gibson's sketch says, "Odour of red raspberries," but the fragrance disappears and gives place to a peculiar faint disagreeable odour when the flower withers. The name is derived from the Greek words meaning snake and mouth.

The leaves are oval lanceolate, three inches long at the most; the lower one has a slender stem, but the others rise from the stalk. At the summit of this smooth, round, grass-like stalk is a strongly ribbed green leaf-like bract, from which springs the solitary flower, or very occasionally two. It is of a warm but delicate pure rose pink, with sepals and petals nearly equal, and almost an inch long.

The deeply fringed and drooping lip has a raised and rounded cushion in the centre, which is thickly crested at the lower part with white and yellow bristles. The whole flower, including the column, is bent almost at a right angle to the three-angled deeply ribbed ovary, so that it appears to nod upon its stalk.

The contrivance to protect this orchid from fertilising itself and to insure cross fertilisation is very interesting (Plate XXVIII., Fig. 1).

The column lies almost horizontal, and projects over the fringed lip in such a way that when an insect lights on its crested ridge and crawls unevenly through the stout hairs it would strike its head and back first against the anther lid, which fits like the hinged lid of a box, and which is pressed down tightly by the insect entrance, and then against the surface of the stigma which lies directly under the anther.

There is no thoroughfare in this orchid, and no space to turn around, so that the insect is obliged to back out, and in so doing he catches his head on a little rim of the anther lid that grows there on purpose, and immediately the disc that covered the pollen springs back like the lid of a watch, leaving the pollen masses exposed in a little grooved opening, in such a way that the insect must receive them on his head. It seems quite possible that the heavy beard of bristles on the lip adds just the touch of difficulty in the path of his retreat to cause him to tiptoe awkwardly backward and insure his stumbling against the rim on the lid in just the right way to open it. The moment the insect has withdrawn, the lid closes with a snap and shuts in for another insect any of the pollen mass that was not carried away. That which adheres to the first visitor's head is carried straight against the flat, round stigma of the next flower it visits.

The Rose Pogonia grows in meadows and swamps through Canada, all the way from Newfoundland and Ontario, across the continent and as far south as Florida on the coast and Kansas in the Midland States. It also grows in Japan, but as far as we know in no other part of the world. It is overwhelming to think that before the Pacific Ocean knew its present bounds, in that dim age when no sea separated the coast of Japan from our shores—that then this rose-pink blossom grew, perhaps profusely, as became the presiding flower families which were then among the monocotyledons, as profusely as the daisies and golden-rod of to-day; and that since Japan has become an island

garden, this plant, so widely separated in space, has gone on reproducing itself there and here without variation, through æons of time.

### 2. NODDING POGONIA, OR THREE BIRDS

*Pogonia trianthophora* (Sw.) B. S. P. (Plate XXX.)

FORMERLY called *Pogonia pendula*, as descriptive of the drooping flowers.

A delicate, feeble-looking little orchid is this Pogonia, with its small scattered leaves and its drooping, fluttering, pinkish blossoms that average about three on the stalk and give it the native rustic name "Three Birds."

Its smooth, slender stem grows from three to eight inches high, though six inches is its usual height. It springs from a fleshy root and bears from two to eight very small ovate leaves, a half, or at the very most, three-quarters of an inch long. They grow alternately on the crooked curving stalk and clasp it all the way around. From the axils of the upper leaves the flowers grow on slender stalks that at first stand erect but soon droop like a fuchsia. There may be only one blossom and occasionally as many as seven, but the usual number is three or four.

The blossoms themselves are of that faint rose colour that the botanists call purple, fading to white, and are slightly fragrant. The sepals and petals are all the same colour and about equal in length, from a half to nearly three-quarters of an inch long. They are elliptical with rounded

XXX. Nodding Pogonia, or Three Birds

XXXI. Spreading Pogonia

ends, and they converge a little at the tips. The tip hangs broader at the end and is notched and cleft to suggest an attempt at becoming three-lobed. It has no crest or beard, but has three tiny green lines which may possibly secrete nectar.

Just how this blossom attracts insects, and which these are, is not known. Its anther and stigma are so small that it is difficult to see the hinged lids that open and shut to let the pollen out, but what we know of the persistency of family habits makes us sure that the existence of this plant depends on a well-established connection with some insect visitor.

This Pogonia is the latest one of the summer, as it does not begin to flower until August and lasts through September. It grows in swamps and in moist, damp woods, but is not as common in the New England States as it is in the South. In North Carolina it blooms in the valleys and climbs the mountains to a height of 3,500 feet, and it is very much at home in Florida.

### 3. SPREADING POGONIA

*Pogonia divaricata* (L.) R. Br. (Plate XXXI.)

THE Spreading Pogonia, with its solitary bracted inch-long flower at the summit of a tall slender stem, looks at first glance much like the Snake-mouth previously described, but it lacks the beard on the crested lip that is characteristic of *Pogonia ophioglossoides*, and has several other distinguishing features.

It springs from a fibrous root, and in height it is much the same, but may grow to two feet. Instead of two or three leaves, it has but one—narrow, long and blunt pointed—that clasps the stalk, and that is from two to four inches in length.

The flower nods, but is not so much at right angles to the stem as the Snake-mouth, for the sepals spread widely and stand up more stiffly, and are the characteristic sign of the species that gives it the name "spreading."

They are very narrow, darker in colour and longer than the flesh-coloured petals. The lip is the same length as the other two petals, but instead of being narrow and pointed at the tips as they are, it is broader, three-lobed, with a wavy margin and a longer lobe in the centre, and is greenish with fine purple veins. It has a crest in the middle, but no beard.

The anther sacs that lie on each side of the shield and just in front of the stigma have a hinged cup at the end that lifts like a lid with toothed edges that helps to hold the pollen in.

This Pogonia is a Southern species that has never ventured farther north than the swamps in southern New Jersey. It ascends to 4,000 feet in North Carolina and grows in Florida. It blossoms in July.

### 4. WHORLED POGONIA

*Pogonia verticillata* (Willd.) Nutt. (Plate XXXII.)

THERE are two Whorled Pogonias which may be instantly distinguished from the other Pogonias by the circle of five

XXXII. Whorled Pogonia

XXXIII. Smaller Whorled Pogonia

leaves that stand stiffly at the summit of the stem beneath the blossom; and from each other by the fact that *Pogonia verticillata* has very long, narrow sepals, while *Pogonia affinis* has sepals barely, if any longer than the petals.

*Pogonia verticillata* (Plate XXXII.) has long, fibrous roots and grows nearly a foot high. The leaves of the whorl are from one to three inches long, and spring directly from the stem without leaf stalks; they are obovate and abruptly pointed. From their midst rises the flower stalk, erect in the bud, but drooping in the flower, and longer than the capsule when it is ripe.

The sepals, mere dusky, purple straps, growing from one and a half to two inches long, give the blossom a wild, twisted, fantastic appearance, but they are not vivid enough to make it striking, for the petals are also inconspicuous, being narrow and greenish and only a quarter of the length of the sepals. Some botanists have described the flower as yellow with brownish sepals; but the green predominates.

The lip (Plate XII., Fig. 2) is exquisitely modelled, with a three-lobed wavy margin and upturned edges that form a narrow trough leading straight to the anther cells. The passage through which an insect must walk is over a long, roughened, narrow crest. Perhaps he prefers to walk up one side or the other and thus crawl in obliquely and touch off the spring cap of the anther cells. Whichever is the insect that fertilises this rather rare and fastidious orchid, he generally finds enough work to keep him busy transferring the powdery pollen masses, for as a rule the plants grow in a

little colony, and when one is fortunate enough to come across one in a damp wood or swamp, or possibly in a dry wood, one is apt to find a host of them. They are often found in the company of Medeola, a member of the Lily-of the-Valley family that has a whorl of leaves closely resembling this orchid's leaves. The dwarf cornel leaves also look similar, but after the flower has passed, the orchid may be recognised by its single capsule with its many seeds, while the dwarf cornel wears the familiar scarlet "bunchberries," and the Medeola beautiful, blue-purple berries. Its range is from Southern New England to Minnesota, and southward, and its blossoming time is May and June, but its tendency, like that of the other Pogonias, is toward the warmer climate, for it has not been reported, we think, from Maine or New Hampshire or Vermont.

### 5. SMALLER WHORLED POGONIA

*Pogonia affinis*, Austin. (Plate XXXIII.)

This orchid is truly a rarity. The Smaller Whorled Orchid has been found so seldom in our moist woods of southern New York and New Jersey as to make us feel as though we were holding some Southern bird in forced captivity in insisting on keeping it within the printed lists of our flora. Whether its seeds have travelled north from its more congenial clime by accident, or whether our few specimens are lingering in a climate that has become too severe, we cannot say; but certain it is, if it be a feat to find the *Pogonia*

*verticillata*, it is worth a letter to the state botanist to report *Pogonia affinis*, for the last published word of science is that "the species is imperfectly known either here or elsewhere."

The foregoing description of *Pogonia verticillata* would answer for it, if reduced by one-third as far as size is concerned, but there are several points of difference. The flowers, which are sometimes two instead of one, are greenish yellow and have a short flower stalk, never over a third of an inch in length, and the narrow sepals, instead of flying like stiff dark ribbons, are as short, or but a trifle longer than the petals.

Of its insect visitors and its mechanical anther lids we cannot speak, for it is so rare that the illustration had to be made from the pressed specimen found and named by Mr. Austin.

## V

## ARETHUSA

### *Arethusa bulbosa* L. (Plate XXXIV.)

One of the most charming of the spring flowers that flutters on its grass-like stem over cranberry bogs and Adirondack swamps and salt marshes is the nymph-named Arethusa, a rose-purple blossom that at first looks very like the Snake-mouth.

By plucking the plant from its wet sphagnum bed, it will be seen that it grows from a small bulb instead of from a fibrous root, whence its name, *bulbosa*. Its sheathed stem is low, sometimes only five and at most ten or twelve inches high, and has a single, long, grass-like leaf that may grow six inches in length after the flowering time has passed. The flower is large for the length of its stalk, sometimes growing two inches long. It is not bent over as much as the Snake-mouth, but the arching of one sepal and two petals over the column gives it a characteristic poise. The other sepals that are long and narrow, like the arched one, are recurved and spreading, and the lip, that curiously decked banner that is the honey signal to the insects, drops to the breeze a broad, round, fringed and notched banner covered with purple blotches and ridged with three crests of fine white hairs.

Under the crimson-purple canopy the column is spread out like a petal, and covers the anther, which in turn lies directly over and projects beyond the stigma, in such a way that the pollen could no more fall upon it than could a sticky pop-corn ball fall and adhere to the under side of the shelf it was lying on. The anther projects like a pointed helmet beyond the stigma, and remains tightly closed, holding under it four little loose soft pellets of pollen, two in each cell. The bee that creeps along the hairy channels that lead to the nectar in the orchid's cup pries the pointed cap off as he is backing out of the flower, and immediately it springs up on a hinge and the pollen masses are caught in the hairs of his head, and are soon deposited upon the stigma of another flower as he creeps under it to get to the nectar.

In Plate XXXIV., Fig. 2, the mechanism of this plan is shown. In *A* the cap of the anther is closed, and as the bee advances to thrust his tongue into the nectar sac, he seems to press the edge of the anther inward and thus keep it even more effectually closed.

"As the bee retires, the backward motion opens the lid, and the sticky pollen is thus brought against the insect's back, where it adheres in a solid mass. He now flies to the next Arethusa blossom, enters it as before, and in retiring slides his back against the receptive viscid stigma, which retains a portion of the pollen, and thus effects the cross fertilisation. Professor Gray surmised that the pollen was withdrawn on the insect's head, and it might be so withdrawn, but in other allied orchids of the tribe Arethusa, in which

the structure is very similar, the pollen is deposited on the thorax, and such is probably the case in this species. In either case cross fertilisation would be effected. Nothing else is possible in the flower, and whether it is *Bombus* or not that effects it, the method is sufficiently evident."

Mr. Gibson says: "I have never happened to observe an insect at work upon this flower, but the intention of its structure is so plain that by a mere examination we may safely prophesy, not only what must happen when the insect seeks its nectar, but with equal assurance the kind of insect thus invited and expected. The column is here quite elongated, forked at the tip, the space between the forks occupied by the anther, which is hinged to the upper division. This anther lid is closed tightly, with the sticky mass of pollen hidden behind it in the cavity. The stigma is on the external inner side of the lower division, and thus distinctly separated from the pollen. The lip is extended forward as a hospitable threshold for the insect. And to what insect might we assume this invitation of colour, fragrance, nectar and threshold to be extended?

"Let us consider the flower simply as a device to insure its own cross fertilisation. The insect is welcomed; it must alight and sip the nectar; in departing it must bear away this pollen upon its body, and convey it to the next Arethusa blossom which it visits, and leave it upon its stigma. These are the conditions expressed; and how admirably they are fulfilled we may observe when we examine flower after flower of a group, and find their nectaries drained, their

XXXIV

Fig. 1. Arethusa. Fig. 2. Anther and stigma.

3

2

XXXV. Helleborine

**Fig. 1.** Flower stalk. Figs. 2. and 3. View of the blossom, with sepals and petals (lip excepted) removed to show pollen masses lying under the anther.

anther cells empty, and pollen upon their stigmas. The nectar is here secreted in a well—not very deep—and the depth of this nectar from the entrance is of great significance among all the flowers, having distinct reference to the length of the tongue which is expected to sip it. In the Arethusa, it is true, the butterfly or moth might sip at the throat of the flower, but the long tongues of these insects might permit the nectary to be drained without bringing their bodies in contact with the stigma. Smaller insects might creep into the nectary and sip without the intended fulfilment.

"It is clear that to neither of such visitors is the welcome extended. What, then, are the required conditions? The insect must have a tongue of such a length that, when in the act of sipping, its head must pass beyond the anther well into the opening of the flower. Its body must be sufficiently large to come in contact with the anther. Such requisites are perfectly fulfilled by the humblebee, and we may well hazard the prophecy that the *Bombus* is the welcome affinity of the flower."

On some parts of the northern New England seacoast the marshes are purple tinted in June with the blossoms of Arethusa, but while the artist is revelling in the mass of colour, the little artisans are clumsily but skilfully buzzing from flower to flower, snapping open the treasure boxes and transferring the hoards from one to another, until, after the brief season of riotous colour and sweetest perfume, every flower has been visited and has set its seed.

## VI

# EPIPACTIS

### HELLEBORINE

*Epipactis viridiflora* (Hoffm.) Reichb. (Plate XXXV.)

Of the ten species of Epipactis or Helleborine that grow in Europe only two are found in the United States. One grows in the Western States, and one in the East. The Eastern species is *Epipactis viridiflora*. It is common in Europe, but so rare in this country that it has been reported only from near Toronto in Ontario, and from Syracuse and Buffalo in New York.

It must always be remembered, however, when a flower is reported from very few places, that the writers of manuals take their localities only from reliable printed floræ of states, or from herbarium specimens. Therefore, unless a botanist has noticed it, it cannot technically exist. Doubtless there are waste places of beauty the whole country over where the Helleborine may grow with no one to notice it save hunters or fishermen. That it is found near large cities means rather that botanists live in the cities and journey on holidays a little way forth in the country with their botany boxes, and collect the nearest specimens, and not that it has a special tendency to haunt the homes of men.

Doubtless its leaves may have often been mistaken by the novice for the leaves of Hellebore; for the tall, stout stem of Epipactis, with its ovate clasping leaves, sometimes looks at first glance like this common herb. Its scientific name, Epipactis, means Hellebore in Greek, and for lack of a scientific eye, and a more distinctive name, it may grow in many places unknown to botanists.

The genus Epipactis belongs to the same group as Peramium, Gyrostachis and Listera. It was a genus that Darwin loved to watch, and one on which the great authority on cross fertilisation, Dr. H. Müller, wrote a memoir.

The European species that most nearly resembles our rare American Helleborine is *Epipactis latiflora*, in fact, ours was once called variety *viridiflora*, of that species; therefore the best idea we can get of the mechanism of the pollen and stigma is from Darwin's description of *Epipactis latifolia*.

It is necessary to tear off the petals and sepals and leave only the jointed hanging lip to see just how the column lies.

In Plate XXXV., Figs. 2 and 3, *a*, as seen in the front view as well as the side view, projects well forward, and contains two pollen masses on its under side. Beneath it, with the sticky surface undermost, lies the stigma (*s*). The beak or rostellum is formed like a round knob, and projects beyond the stigma and underneath the anther. This knob is covered on its upper side with such a tender membrane that Darwin found he could prick it through with a human hair, and that when he did so, or even without provocation, a slight viscid milk would ooze out, which would render the

upper surface of the knob very sticky. He also found that the whole knob or rostellum would come off if it were shoved very slightly upward and backward, and that its under side was also adhesive, and would dry fast to anything to which it stuck.

He examined flowers while still in the bud, and found that, before the flower expands the anther opens, and exposes the pollen masses.

These lie in round grains that stick together in fours. Each group of four is tied around by a fine elastic thread, and the sum total of all the threads is collected into a bundle that looks, under a magnifying glass, like a brown spot in front of the pollen. It is this bundle or knot of threads that becomes pressed against the knobby rostellum in the bud, the moment the anther opens. It sticks fast, and anything that will remove the rostellum will naturally pull the pollen masses out of their sockets in the anther.

As the flowers stand out almost horizontally from the stem, the curiously shaped lip hangs out invitingly. The lower portion of it is rounded into a pouch in which the nectar lies, and the lip end is hinged and forms a landing place for insects.

As the insect alights on this porch or clings to its swinging hinged tip, he bends down into the honey cup and takes his fill, then flying out and upward, his head strikes the sticky under surface of the knob-like rostellum and drags off the cap, to the upper surface of which the pollen is adhering.

His observation of the insect visitors to *Epipactis latifolia*

Darwin describes thus: "As some plants grew close to my house, I have been able to observe here and elsewhere their manner of fertilisation during several years. Although live bees and bumblebees of many kinds were constantly flying over the plants, I never saw a bee or any Dipterous insect visit the flowers; but in Germany Sprengel caught a fly with the pollinia of this plant attached to its back. On the other hand, I have repeatedly observed the common wasp (*Vespa sylvestris*) sucking the nectar out of the open cup-shaped labellum. I thus saw the act of fertilisation affected by the pollen masses being removed by wasps, and afterward carried attached to their foreheads to other flowers. . . . It is remarkable that the sweet nectar of this Epipactis should not be attractive to any kind of bee. If wasps were to become extinct in any district, so probably would the *Epipactis latifolia*."

Possibly the scarcity of our American species, *Epipactis viridiflora*, is due to the fact that its own particular insect servitor has grown more scarce. Hive bees visit another English species of Epipactis, for Darwin's son, William, saw them in the Isle of Wight visiting about a score of flowers, and many of them had pollen masses attached to their foreheads. He also noticed that the elastic character of the hinged lip which tended to spring up as the bees left the flowers seemed to make the bees fly upward in such a way as to strike against the knob of the rostellum. Darwin asked a friend to try an experiment to see whether this hinged lip was an advantage to the flower; accordingly

eight specimens were selected and marked, and the jointed parts of the lip removed. The result was that only two out of the eight bore as many seeds as the unmutilated flowers on the same stalk and six capsules contained fewer seeds. In another experiment, three out of eleven mutilated flowers set no seed. These experiments would seem to show that the elastic upspringing of the lip was of advantage to the flower.

Whoever would seek *Epipactis viridiflora*, our one rare Helleborine that grows in the East, must look for a short herb with fibrous roots and a simple leafy stem, from one to two feet high. The leaves are ovate-lanceolate, from one and one-half to three inches long. They are downy above, and strongly veined and clasp the stem without a pedicel.

The flowers grow in a leafy-bracted, one-sided raceme and are greenish yellow or sometimes purple. They are not quite half an inch long and barely as long as the sharp, narrow bracts that spring from the base of the flower pedicels. The flowers stand obliquely erect, and the contracted lip with its horny cap and hinged, pointed tip stands off at right angles. All the sepals and petals are separate, and from their midst the column with its projecting anther is plainly visible.

Dr. Britton, in his "Flora of the Northern States and Canada," notes that this species is "sometimes confounded with the European *E. latifolia*, but differs in having the lip free from callosities, its apex acute, and the sepals and petals large and more tapering." It blooms in July and August.

## VII

## GYROSTACHYS

LADY'S-TRESSES. (Plate XXXVI.)

THE genus has been until recently called Spiranthes, from two Greek words, meaning spiral flowers, but the other Greek name, Gyrostachys, has become adopted, with its more literal meaning of twisted stalk.

Gyrostachys is a genus with tiny white flowers hardly larger than the little single trumpets that go to make up a head of white clover. But there is no resemblance between them, except in the yellowish or greenish tinge of the white blossoms, for they are arranged on a slender white stalk which is more or less twisted, giving some plants an appearance of the little white blossoms chasing each other around and around the flower stalk.

The common name of Lady's-Tresses is rather fanciful, unless we try to imagine that a bunch of very twisted *Gyrostachys gracilis* looks like a cluster of loose curls.

The plants rise from tuberous or fleshy fibrous roots, and have narrow leaves springing from the base of the stalk or growing on its lower portion. If there were any danger of confusing the white blossoms with those of the Habenarias, a glance would show that the flowers of the Lady's-Tresses

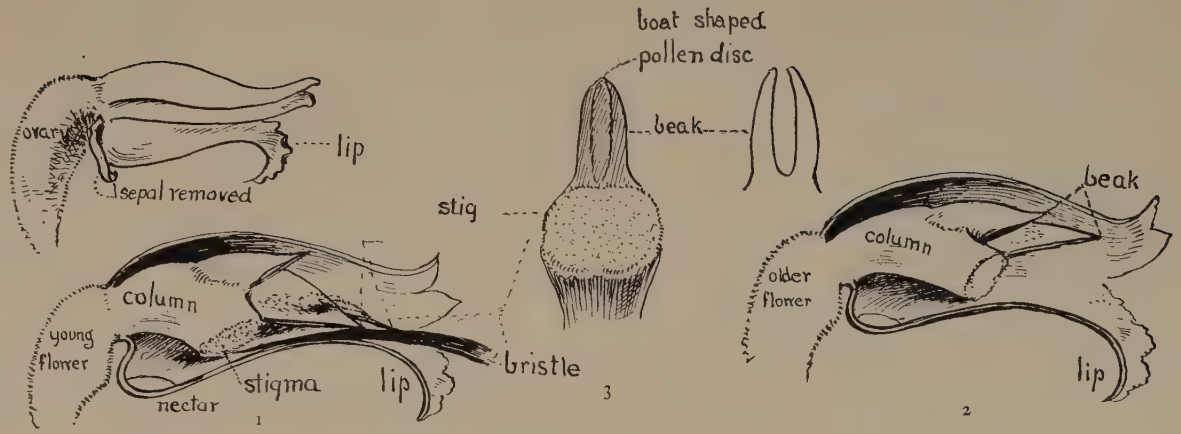
have no spur, while all the more common native Habenarias have a spurred lip.

These sweet-smelling white wands of bee-beloved flowers are many and beautiful in tropical countries. The genus numbers eighty species, of which seven grow in our temperate limit. One in the Southern States and another in California, bring the number up to nine.

The English species furnished Darwin with an elaborate and minute task in discovering the secrets of their domestic economy. The flowers are so small and their mechanism so complex and minute that it required a microscope to discover the curious shape as well as the actions of the stigma and anther; but patient experiment revealed a structure most emphatically adapted to cross fertilisation.

The "Autumnal Spiranthes" was the particular Lady's-Tresses that Darwin prisoned in nets, and tickled with bristles to make it disclose its secrets; and having discovered them, he wrote to Professor Asa Gray, his kindred spirit in America, and asked him to examine the Lady's-Tresses that were familiar to him. Our seer of the woods studied *Gyrostachys* (*Spiranthes*) *gracilis* and *cernua*, and found that they had the same general structure.

If one selects a young flower (Plate XXXVI, Fig. 1), whose trumpet petals have just blown, and peers into its microscopic depths with a pocket lens, there will be seen a small dark dot which is the end of a thin tapering beak that projects like a little shelf over the stigma. Along the middle of this beak, or rostellum, as it is technically called, lies a




XXXVI. Gyrostachys

Sections Cut Lengthwise Through a Flower of the Slender Lady's-Tresses, Showing the Mechanism of the Parts

Fig. 1. Young flower, with pollen. Fig. 2. Older flower, with stigma raised up. Fig. 3. Stigma prolonged into a beak holding the pollen mass.

small ridge. As innocent as the trick egg of a magician is this minute furrow, but touch it ever so lightly with a fine bristle, and presto, the beak splits and an elliptical crack rounds through its length and loosens a little sticky boat-shaped disc that adheres to the bristle as it is drawn away (Plate XXXVI, Fig. 3). The column, that is, the whole apparatus of stigma, anthers and beak, lies so closely pressed against the lip of the Lady's-Tresses that a bee alighting on this threshold cannot stick his proboscis into the honey well without doing the trick of the bristle, for the slightest touch, even the irritating vapour of chloroform, will start the split. Consequently, the bee goes off with a tiny boat glued fast to his proboscis. This would not mean much, were it not that long before the flower expands the anther cells, which are pressed just over the beak or rostellum, open and let the pollen masses fall right on the boat; so that as the bee flies away he carries a freighted cargo that has been awaiting transportation.

Darwin says: "At Torquay, I watched for about half an hour a number of these flowers growing together, and saw three kinds of bumblebees visit them. I caught one and examined its proboscis; on the superior lamina, some little way from the tip, two perfect pollinia (pollen masses) were attached, and three other boat-formed discs without pollen; so that this bee had removed the pollinia from five flowers and had probably left the pollen of three on the stigmas of other flowers."

But is not the bee, as she thrusts her proboscis in beneath

the column to sip the nectar, to tip the little boat of pollen that has just stuck to it, right against the stigma of the same flower? Not in the least, for in the young just-opened flower the column lies so close to the tip that the bee can barely force her proboscis through; moreover the stigma is not sticky, and would not hold the pollen even if the bee could get it there. But as the flower grows older, the bent column slowly raises itself from the lip (Plate XXXVI., Fig. 2), leaving a much wider aperture into which the proboscis can go far enough to unload the pollen on the surface of the stigma, which has by this time become sticky. Asa Gray writes humbly to Darwin, who called his attention to this widening of the passage, "It is so sticky we wonder how we overlooked it."

Still it may not be quite clear how this widening of the passage ensures cross fertilisation, for might not the bee carry the boat-loads of pollen from a young flower to an older flower on the same spike, and cause self fertilisation? We must turn to Darwin again for a simple observation which gives the key to the situation. He noticed that "the bees always alighted at the bottom of the spike, and crawling spirally up it, sucked one flower after another. I believe," he adds, "humblebees generally act in this manner when visiting a dense spike of flowers, as it is the most convenient method—on the same principle that a woodpecker always climbs up a tree in search of insects." This seems an insignificant observation, but see the result. The bee goes first to the lowest flower, and crawling spirally up the spike,

effects nothing on the first spike which she visits till she reaches the upper flowers, and then she withdraws the pollinia (pollen masses). She soon flies to another plant, and alighting on the lowest and oldest flower, into which a wide passage will have been formed from the greater reflexion of the column, the pollinia strikes the protuberant stigma. If the stigma of the lowest flower has already been fully fertilised, little or no pollen will be left on its dried surface; but on the next succeeding flower, of which the stigma is adhesive, large sheets of pollen will be left. Then as soon as the bee arrives near the summit of the spike she will withdraw fresh pollinia, will fly to the lower flowers on another plant, and fertilise them. Thus as she goes her rounds and adds to her store of honey, she continually fertilises fresh flowers and perpetuates the race of our autumnal Spiranthes, which will yield honey to future generations of bees.

KEY TO THE SPECIES OF GYROSTACHYS

| | |
|---|---|
| Flowers growing in three ranks around stem; stem not twisted or only slightly so. | |
| Sepals and petals curving together to form a little hood. | 1. Hooded Lady's-Tresses. |
| Lateral sepals standing free and separate. | |
| Spike short, slender, two inches long, four or five wide leaves on stem. | 2. Wide-leaved Lady's-Tresses. |
| Spike four to six inches long, plant growing six inches to two feet; lip with hairy, straight knobs at base. | 3. Nodding Lady's-Tresses. |

Stem one to two feet high, lower leaves very long, upper ones mere bracts; lip with smooth, incurved knobs at base. — 4. Fragrant Lady's-Tresses.

Flowers alternate, but on a twisted stalk.
Stem leafy, leaves like blades of grass. — 5. Grass-leaved Lady's-Tresses.

Stem with bracts, basal leaves withering before the flowers come.
Plant small, five to nine inches high, spike one inch long. — 6. Little Lady's-Slipper.

Plant slender, basal leaves ovate, loose spike one to three inches long, very much twisted. — 7. Slender Lady's-Tresses.

### 1. THE HOODED LADY'S-TRESSES

*Gyrostachys Romanzoffiana* (Cham.) MacM. (Plate XXXVII.)

From a cluster of tuberous roots a smooth stem, leafy in its lower part, and bracted above, bears a spike of flowers two to four inches long. From six to fifteen inches is the height of this species. The leaves, which are broader at their upper end than at their long, tapering base, sometimes grow to be eight inches long, though five is the average length.

The whitish or greenish flowers grow in three rows around the stem; they are very small, about a quarter of an inch long. As the stem is not twisted, they circle it regu-

larly, standing horizontal to it, and making an evenly flowered wand. The sepals and petals are broad at the base and curved together to form the little hood that gives the species its common name. The thin, transparent, veiny lip is oblong, and contracted near the base without any thickened protuberances.

The Hooded Lady's-Tresses has a sweet fragrance of violets, and is so like the Nodding Lady's-Tresses that one is deceived into thinking that one has found this more northern species, when it is in reality the commoner Nodding Lady's-Tresses.

The time of flowering is characteristic, however; July and August are the months for the Hooded, and the late autumn for the Nodding Lady's-Tresses.

It has travelled widely, for it is found in bogs through Maine and Canada, to Lake Superior and across the continent, where it ranges from Unalaska south to California and Colorado. It even climbs mountains to the height of six and eight thousand feet. But though it is found in so many stations with us, it is a rarity in Europe, appearing only in a few bogs in Cork County, Ireland, where Grant Allen says, "The ardour of modern botanists is fast putting an end to its brief career."

How did it get there? Professor Gray thought that these were merely the last lingering stations of a species once common to both continents, while Grant Allen thinks that the seeds were "carried across the ocean by chance at some remote period." But it could hardly be that this wild,

shy orchid of our cold bogs should find its way by any returning traveller to just the sort of damp seclusion that it loves. Moreover, if it had done so, it must have been very long ago, for when it was first discovered by botanists, it was called by a different name, for it varies very slightly from our type, just enough to make it seem that either the Irish or the American climate had caused a slight evolution from the common ancestors of both. Strange marvel, that this small white wand of flowers should point to a half-written page in the world's geological history, and that its mere unconscious presence should illustrate the growth of the slowly shifting continents.

### 2. WIDE-LEAVED LADY'S-TRESSES

*Gyrostachys plantaginea* (Raff.) Britton. (Plate XXXVIII.)

The small white Lady's-Tresses, with its broad-bladed, tapering, clasping leaves, is shorter than any, growing sometimes only four inches, never more than ten in height. Its minute quarter-inch blossoms coil around the straight, untwisted stem, and form a very small spike from one to two inches long and not half an inch wide.

On plucking off a tiny blossom and looking at it with a magnifying glass, it will be seen, as illustrated (Fig. 3), that the bracts are very much shorter than the flowers, and that the petals and velvet sepals are all very narrow and incurved at the end. The overhanging lip, pale yellow on its face, has a rounded margin wavy and crisped, while at its

XXXVII. Hooded Lady's-Tresses

XXXVIII

Fig. 1. Wide-leaved Ladys'-Tresses. Fig. 2. Front view of flower, showing shape of lip.
Fig. 3. Side view, showing shape of flower.

point of attachment there are no protuberances, but sometimes little thickened places (Figs. 2, 3).

This is the earliest of the Lady's-Tresses to bloom. It begins in June and lasts till August, but loves cold, wet woods and damp meadows in New York and New England. Its range is from New Brunswick to Minnesota, and south to Virginia, but seldom, if ever, beyond the Mississippi.

### 3. NODDING LADY'S-TRESSES

*Gyrostachys cernua* (L.) Kuntze. (Plate XXXIX.)

THIS is the most beautiful of our Lady's-Tresses and the latest to bloom.

The stalk varies greatly in size, from six inches to two feet. It is downy in its upper part, and is wrapped by several pointed bracts. The long, narrow leaves all spring from the base or near it, and are sometimes more than a foot long, though they may not exceed three inches in breadth. They are not so grass-like as in the Grassy Lady's-Tresses, being distinctly wider at the end and narrowed into a sort of leaf stalk above the middle, but as the leaves are apt to wither away when the flower blooms, it has the appearance of rising almost bare stalked from the ground.

The spike is four or five inches long and about half an inch in diameter. The tiny yellowish-white flowers, not half an inch long, nod on their short-flowered stalks and climb around the stalk, each third one peering around and down at the one below it. The sepals at the side are free

and spreading, but the upper sepal and the two upper petals are arched over the column (Fig. 2).

The lip, as it stands invitingly below the entrance of the older flower in the illustration, whose passage is open wide enough for the bee to carry the pollen masses in, is oblong and obtusely pointed. It is wavy, crisped around the edge and has at its base two little callous knobs (Fig. 4).

It is distinctly an October orchid, though it begins to bloom in August or September. From Nova Scotia to the Gulf of Mexico, and as far west as the Mississippi it is common in wet meadows and swamps. When Indian summer warms the brown meadows and swamps, and those second adventists, the violets and clover, reappear to mortals before the summer dies, the Nodding Lady's-Tresses shine like slim white ghosts between the grass and sedges, and shed a faint, sweet almond perfume through the air.

### 4. THE FRAGRANT LADY'S-TRESSES

*Gyrostachys odorata* (Nutt.) Kuntze. (Plate XXXIX., Fig. 5.)

THE fragrant Lady's-Tresses is not the only one with a perfume, but it is the one that receives the name *odorata* as its characteristic sign.

It strongly resembles the Nodding Lady's-Tresses (Plate XXXIX., Fig. 6), but has a distinguishing characteristic in the lip. The little thumbs at the base of the lip, the nipple-shaped callosities, as the technical botanies called them, are smooth and incurved in the Fragrant (Fig. 5), instead

of hairy and straight, as in the Nodding Lady's-Tresses (Fig. 4), and the lip itself is beautifully pinched and curved in at the middle (Fig. 5), and very downy above; the leaves that spring from the base are eight to fifteen inches long, and narrow, from a two-inch blade with a long leaf stalk that clasps the stem. The other stem leaves are mere bracts.

The flowering spike is the stoutest and thickest of all the American species, growing five or six inches long and averaging three-quarters of an inch in thickness. The thick, long bracts that grow beneath the yellowish-white flowers help to lend this effect, for they project beyond them.

The Fragrant Lady's-Tresses is not found in the Northern woods, but grows only from North Carolina to Kentucky, Florida and Louisiana, where in September and October it haunts the river banks, even growing in the water.

### 5. GRASS-LEAVED LADY'S-TRESSES

*Gyrostachys præcox* (Walt.) Kuntze. (Plate XL.)

A TALL, slim, downy-stemmed Lady's-Tresses with a very twisted spike and long grass-like leaves, is the general impression one gets on plucking the Grass-leaved Lady's-Tresses. For more minute description it may be classed among the very tall members, perhaps it is the tallest, for although, like the Nodding and the Slender Lady's-Tresses, it is generally found from one to two feet in height, yet some specimens thirty inches high have been found.

The leaves are the characteristic sign of this species. They are very long and narrow, and, growing in grassy places, the flower stalk appears to rise naked among the grass blades—so closely do the long leaves resemble long grass. They are from two to twelve inches long, about the same length as the leaves of the Nodding Lady's-Tresses, but in the latter the leaves are apt to be slightly wider at the tips, while in this species they are distinctly lance shaped and clasp the stem with long, sheathing petals.

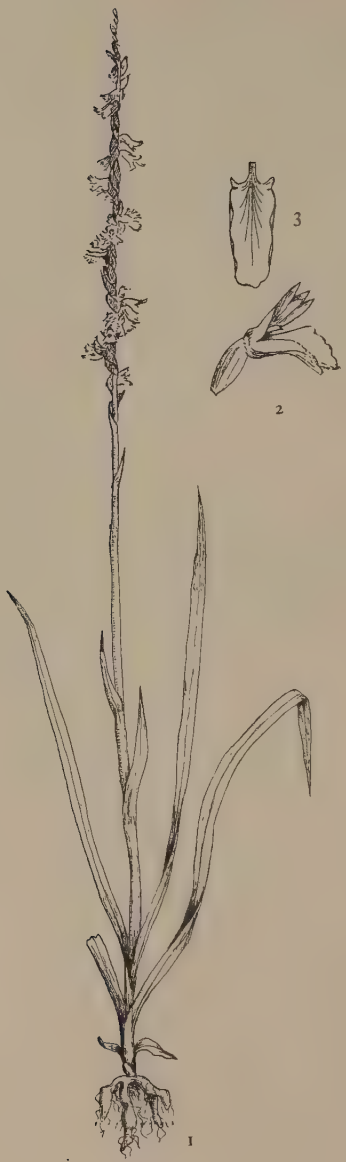
The spike, which grows from two to eight inches long, is twisted around and around, so that the flowers grow, to all appearances, as though they were looking backward with necks craned. The interrupted appearance that the twisting gives the spike, is, however, very artistic as well as characteristic.

The stem bears one rank of flowers that are rather open in their appearance and follow the spiral of the much-twisted stem. At the base of the flowers are leafy bracts as long as the ovaries. The flowers are white or yellowish and about one-third of an inch long (Fig. 2). Their lateral sepals are free, but the upper one converges with the two upper petals. The lip is about a quarter of an inch long and spreads out a little at the bottom, and is slightly contracted above. The margin is loosely wavy and there are dark stripes in the centre and tiny nipple-shaped callosities at the base (Fig. 3).

This orchid is rather uncommon. It resembles the

XXXIX

**Fig. 1.** Nodding Lady's-Tresses. Figs. 2 and 3. Front and side view of single flower. **Fig. 4.** Characteristic lip with knobs. Fig. 5. Characteristic lip of Fragrant Lady's-Tresses.




XL

Fig. 1. Grass-leaved Lady's-Tresses. Fig. 2. Flower. Fig 3. Lip.

Nodding Lady's-Tresses so closely that a novice is apt to mistake one for the other. It grows in grassy places from southern New York to Florida and Louisiana.

### 6. LITTLE LADY'S-TRESSES

*Gyrostachys simplex* (A. Gray) Kuntze. (Plate XLI., Fig. 2.)

A SMALL, fragile, inconspicuous little orchid is this frail plant. It is as small as the other low species, being from five to nine inches high, but it could never be mistaken for it; its root is a single tuber and its stem is not leafy. It has only a few scattered bracts, and the short, ovate or oblong leaves that spring from the base are withered when the flower blossoms, in August and September, so that the appearance is of a slender, leafless stalk bearing a one-inch slightly twisted spike of the most microscopic white blossoms. Nevertheless the little tip, when magnified, shows all the delicate crisping and veining of the large species, and the characteristic horns at its base are quite prominent.

Its habitat is characteristic, as it abandons the low, damp ground, in which the other Lady's-Tresses grow more luxuriantly, and chooses dry and sandy places from Massachusetts to Maryland, where it grows sparsely. It grows in Rhode Island and is one of the treasures of Nantucket, that wild sea-girt garden that retains some living memories of the days when it was a mountain top on the coast of North America. It is not beautiful except to those who see with

their minds the history of a forgotten past, and the mystery of life in the presence of a significant but unnoticeable flower. It blossoms in August and September.

### 7. THE SLENDER LADY'S-TRESSES

*Gyrostachys gracilis* (Bigelow) Kuntze. (Plate XLI., Fig. 2.)

No one could mistake the Slender Lady's-Tresses, which look as though the fairies had threaded spikes of white coral in stalks of grass and twisted them for fun, as children do a string that is to twirl a ball. Around and around in a close-pressed single row these little white flowers, insignificant as individuals, form an odd artistic spike. From a cluster of tuberous roots rises the bare smooth stem with small, sharp-pointed bracts that soon fall off. A few ovate or ovate lanceolate leaves, not more than two inches long and often shorter, rise from small leaf stalks at the base and often wither before the flowers come. The effect is generally that of a green grass stalk with a twisted three-inch spike. It averages eight inches to a foot in height, but may grow two feet high. The minute fragrant flowers are barely a quarter of an inch long, and all turn abruptly to the left, following each other closely up the stalk in a spiral that winds, sometimes once or twice, but oftener five or six times, around the stem.

Minute as the flowers are, they show when highly magnified, as in Plate XXXVI., that when the blossom first opens, the closely pressed upper sepal and two upper petals

limit the bees' entrance except just over the tiny hanging lip, and then the column is pressed so low against it that her proboscis can only just be thrust in. So small is the lip that no bee could use it as a threshold; it merely serves as a little sign to its visitors of the path to the nectaries (see Plate XXXVI).

A proboscis one-third of an inch long would be able to reach the storehouse of this orchid's sweets, but the bees seem to do the most thriving business in honey, and never despise these minute orchids that have no silken chambers. Three different species have been seen visiting them, *Bombus Americanorum*, *Calliopsis andreniformis*, and, in Florida, *Megachile brevis*. "The last-mentioned insect," said Robertson, who had been watching it in its visits to the Slender Lady's-Tresses, "was found with two boat-shaped discs with attached pollen masses fastened to the maxillary laminæ," in such a manner that when the proboscis was folded up, during the bee's flight from one spike to another, the pollen masses would not be disturbed, but the moment it thrust its proboscis into a fully opened flower, they would come right against the stigma.

Nothing could be more exquisitely adjusted than the mechanism of this almost infinitesimal flower, for when after its pollen masses have been removed (Fig. 1), the whole column rises, as is shown in the illustration of the flower of the Slender Lady's-Tresses in Plate XXXVI., and presents the sticky surface of the stigma (Fig. 2) in just the right position to receive the vital touch of the pollen.

Perhaps it is because the mechanism is so perfect that the flower reproduces itself so profusely, for from February, when it blooms in Florida, to April and May in Virginia, and July, August and September in our Northern States and Nova Scotia, this orchid may be found anywhere in dry fields and open woods along the coast and inland to Kansas.

XLI

**Fig. 1.** Slender Lady's-Tresses. **Fig. 2.** Little Lady's-Tresses.

# VIII

## LISTERA

### TWAYBLADE. (Plate XLII.)

In the latter half of the seventeenth century lived a lover of flowers, one Martin Lister, whose interest in science might have brought him nothing but his own pleasure, had not a small inconspicuous orchid been named after him. If he ever published anything himself it has probably been forgotten. All that is recorded of him is that he was a correspondent of the English botanist Ray, and it was probably through this friendship that his name was given to the genus of orchid which is popularly known as Twayblade.

The genus Listera has only some ten species, which live by preference in the arctic or temperate zones. Three grow within our limit and one other in northwestern America.

They are all small, sturdy, fresh little plants, rising rather stoutly from fleshy fibrous roots and bearing midway in their stalks a pair of very bright, crisp, oval leaves. Between these ascends a flower stalk with a few small greenish purplish flowers, that scarcely attract any attention from the passer-by, but have a definite attraction for certain insects. So wise are the insects concerning the charms of

its nectar that spiders build their webs over the blossoms to catch them; so Darwin's son reported to his father, who sent him forth to observe the insects that visited them.

Though none but the orchid hunter might notice the characteristic shape of the leaves and the bird-like fluttering of the blossoms of these little plants that rarely grow more than a few inches high, yet they have had considerable attention from the scientific world.

The very learned Hooker described the structure and action of the rostellum in Listera, but left out the part that insects perform, and Sprengel, who fully appreciated the fact that the construction was adapted to the visits of insects, misunderstood the structure and action of the rostellum, described just how they fertilised, and so failed to tell the whole story.

This Darwin did later, when he had fully established the fact that the insects carry the pollen from one plant to another.

The three species of Listera which concern us have, in addition to the pair of green leaves about the middle of the stem, one or two small scales at the base of the stalk. The flowers are somewhat scattered on a loose raceme that flowers from its base up. They have no spurs, and the sepals and petals look much alike. The anther has no lid and stands erect, joined to the column, and has two powdery pollinia united to a very small gland.

The fruit is in the form of an ovoid capsule, that, per-

sisting in the stalk after the blossoms have withered, helps to define the genus.

Our illustration (Plate XLII.) shows the parts that Darwin studied before he fully learned the mechanism of cross fertilisation of the English species of *Listera ovata*. Fig. 1 is a blossom of *Listera Australis*.

All of the petals except the split lip have been removed (Fig 2), leaving the ribbed ovary and the internal structure of the column. Under the anther (*a*), with its pollen masses (*p*), lies the stigma surface (*s*), with the rostellum projecting out like a thin leaf between. The rostellum is slightly hollow on its upper surface, and is extraordinarily irritable, for no matter how slightly it is touched, with a needle point or a human hair, or even influenced by the vapour of chloroform, a large drop of viscid fluid is instantly expelled.

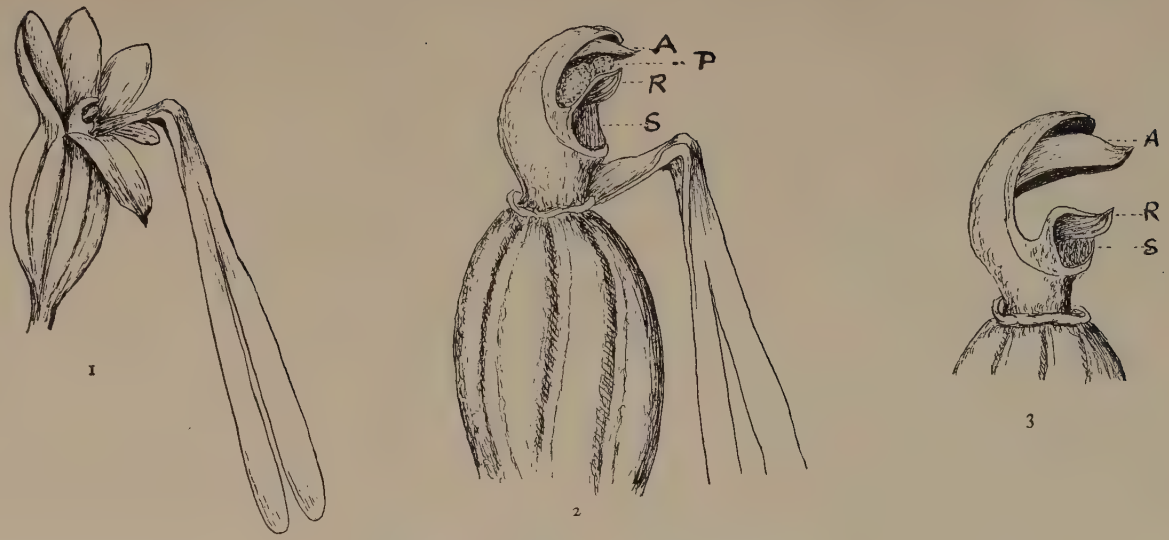
The pointed tips of the pollen masses lie immediately over the rostellum, tied together by a few weak elastic threads that are easily broken.

Darwin observed that the agent that jogged the rostellum, whether artificial needle tip or head of insect, never failed to receive the drop of sticky exudation and the pollen mass at the same time. He noticed that even when a bunch of flowers was carried home in the hand, the sepals or petals that accidentally brushed against the rostellum caused it to explode its sticky drop and glue the pollen mass to the fluttering petals, so that on reaching home it looked as though the flowers had been shooting out their pollen to a distance. He also noticed that after the pollen masses had

been removed the anther sprang back a little, and the rostellum bent its tip so that it hung directly over the lip. Once he found an injured flower in which this had not occurred, and the tip of the anther had become glued fast to the rostellum, so that the pollen masses were hopelessly locked between the two.

Having observed that nectar was secreted copiously along the ridge of the lip above its split end, Darwin went out to see whether the insects worked in the way that his constructive imagination had led him to believe. He says: "In order to witness what I felt sure would take place, I watched for an hour a group of plants on three occasions; each time I saw numerous specimens of two small Hymenopterous insects, namely, a Hæmiteles and a Cryptus, flying about the plants and licking up the nectar; most of the flowers which were visited over and over again already had their pollinia removed, but at last I saw both these species crawl into younger flowers, and suddenly retreat with a pair of bright yellow pollinia sticking to their foreheads. I caught them and found the point of attachment was to the inner edge of the eye; on the other eye of one specimen was a ball of the hardened viscid matter, showing that it had previously removed another pair of pollinia, and in all probability had left them on the stigma of a flower."

As Darwin captured these insects he could not conscientiously say that he saw the act of fertilisation, but he quotes Sprengel, who saw a Hymenopterous insect leave




XLII. Typical Flower of the Genus Listera

Fig. 1. Listera australis. Studied by Darwin. Fig. 2. Flower with all sepals and petals, except lip, removed, before fertilisation. Fig. 3. Same flower after fertilisation.

its pollen mass on the stigma. Darwin's son also watched a bed of Listera at some distance, and brought home insects with the pollen mass attached to the forehead. He also noticed that a great number of spider-webs were spread over the plants, as if the spiders were aware how attractive the Listera was to insects. Darwin also tells us of an observation that shows that the insect world has tragedies in the midst of its daily life. In speaking of how slight a touch is sufficient to cause the rostellum to explode, he says: "I may mention that I found an extremely minute Hymenopterous insect vainly struggling to escape, with its head cemented by the hardened viscid matter to the crest of the rostellum and to the tips of the pollinia. The insect was not as large as one of the pollinia, and after causing the explosion had not strength enough to remove them; it was thus punished for attempting a work beyond its strength, and perished miserably."

The three species that are familiar to us may be recognised by the shape and cutting of the lip.

KEY TO THE SPECIES OF LISTERA

| | |
|---|---|
| Lip broadly wedge-shaped, two-lobed at the apex. | 1. Broad-lipped Twayblade. |
| Lip very narrow and strap-like. | |
| Lip two-cleft and twice as long as petals. | 2. Heart-leaved Twayblade. |
| Lip two-parted and four to eight times as long as petals. | 3. Southern Twayblade. |

### I. BROAD-LIPPED TWAYBLADE

*Listera convallarioides* (Sw.) Torrey. (Plate XLIII., Fig. 1.)

This species of Twayblade looks like a greenish blossom of Lily-of-the-Valley, hence its name *convallarioides*, which means "like the *convallaria*." The two broad, smooth, round, oval leaves are the characteristic sign, and at first sight a novice is apt to think he has found one wild Lily-of-the-Valley, until he notices that the leaves spring from their base. Sometimes they are slightly cordate or kidney shaped at their base. They are three to nine nerved.

The plant grows from four to ten inches in height, of which the flowering raceme is about one-third of its whole length; it is downy in the half above the leaves.

From three to twelve greenish yellow flowers grow upon little thread-like stalks with bracts. The flower is at its largest but a quarter of an inch long, and is composed of very narrow sepals and petals much smaller than the lip. The characteristic shape of the lip is broad and dilated and two lobed, with small ear-like appendages at its base. It is not nearly as deeply cleft as in the other two species. The column is larger than in either of the others, but still much shorter than the lip. It has for its characteristic sign two short wings that project above the anther.

This Twayblade is not uncommon. It grows in woods from Nova Scotia to Alaska and California, and as far south as Vermont; but where the high mountains stretch along the Atlantic coast it follows them as far as North

Carolina, where it ascends as high as 4,500 feet. It blooms from June to August.

### 2. HEART-LEAVED TWAYBLADE

*Listera cordata* (L.) R. Br. (Plate XLIII., Fig. 2.)

This species is known by its very slender stem, which grows from three to ten inches in height, and its tiny pair of heart-shaped pointed leaves, which sit close to the stem, and are only from half an inch to an inch in length. The purplish flowers are so small that they can hardly be seen in their small slender raceme at the end of the stalk. There may be anywhere from four to twenty in the spike, but as the minute sepals and petals are barely one-twelfth of an inch in length, they must be examined with a good magnifying glass. This reveals the cleft nature of the long, narrow lip, that hangs out twice as long as the petals, and the very small column with the clinandrium or depression in the rostellum just showing above the anther.

The slender glabrous character of this Twayblade, contrasted with the more sturdy appearance of its sister, indicates that it grows in damp places. It may be found in wet woods all over the northern part of the continent, as far south as New Jersey and Oregon, as well as in Europe and Asia. Though it has no beauty it has its interest in that its complicated mechanism works as perfectly for minute insects who visit it and carry its pollen masses from plant to plant, with as much persistency as the more showy orchids of the woods.

The mechanism, though on such a tiny scale, is as perfect as it is microscopic, and it has its hosts of minute winged guests for whom it secretes nectar, and who bear away pollen masses and clap them to the stigma of other blossoms, just as in the larger species which Darwin studied.

### 3. SOUTHERN TWAYBLADE

*Listera australis* Lindl. (Plates XLII., XLIII., Fig. 3.)

This Twayblade has the decided characteristic of the genus so markedly that it cannot be mistaken for either of the other two. Its narrow lip is split nearly to the base, and hangs out so much longer than the other minute sepals and petals that it is almost all that is visible of the flower.

The height of the plant is the same as of the other species, running from four to ten inches. Its smooth, shining leaves are ovate and rather sharply pointed. There are also a tiny pair under an inch in length, very rarely accompanied by a third leaf just under the flowers.

The infinitesimal flowers are olive purple and so small that they are only one-quarter or one-eighth as long as the half-inch divided lip, but they stand bravely out on the somewhat downy flower stalk, waving their slit pennants in the wind.

It is a bog plant growing in New York and New Jersey, and found as far south as Alabama and Louisiana.

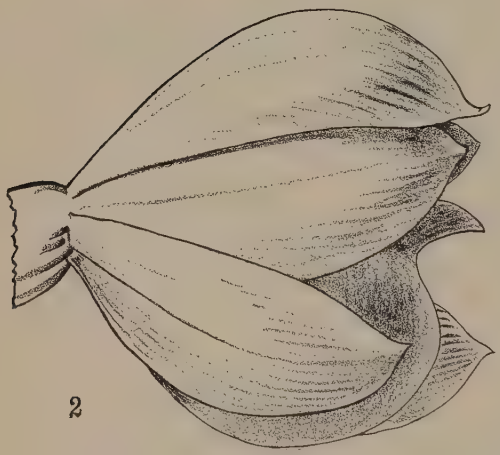
1 3 2

XLIII

Fig. 1. Broad-lipped Twayblade. Fig. 2. Heart-leaved Twayblade. Fig. 3. Southern Twayblade.

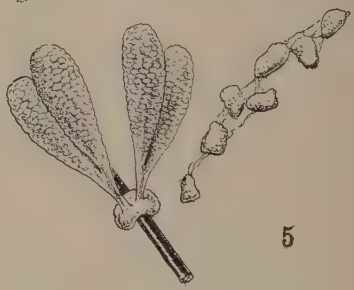
1

3



2

4



5

XLIV. Rattlesnake Plantain. Typical Flowers Showing Method of Cross Fertilisation

Fig. 1. Showing the opening, the anther sacs seen. Fig. 2. Side view of flower. Fig. 3. Section through flower, showing stigma, pollen sacs. Fig. 4. Enlarged view of stigma and pollen sacs. Fig. 5. Pollen sacs adherent to pin and also detached, showing loose structure and connecting threads.

## IX

## PERAMIUM

RATTLESNAKE PLANTAIN. (Plate XLIV.)

The Rattlesnake Plantains are one of the features of almost every patch of woods, especially pine woods, from the Atlantic to the Pacific. One expects, as the sun glints between branches on the soft brown carpet patterned with green, to see their neat veiny-leaved rosettes of blue-green velvet pressed against the background. But whoever expects to find it in bloom must search diligently. Baldwin cites the experience of a botanist who had travelled widely in Vermont, but who had not found a flowering specimen for two years. Quoting his own observation, he says: "I happened to be in a little grove of hemlocks two years ago, in September, and noticing that these orchids were quite abundant, counted them roughly. Out of 200 plants of the Downy Rattlesnake Plantain, young and old, only twelve had flowered, and twenty plants of the Creeping Rattlesnake Plantain furnished but two spikes. A more careful estimate in the following year resulted in giving 102 flower spikes from 572 plants, young and old, of the Downy species. One patch that lay like a mat on the ground had 226 plants in it, and but fifteen spikes."

The roots of the Peramium are thick, fleshy fibres, creeping underground, that help them to hold their own in spite of the lesser quantity of seed. It is possible that individual plants blossom only once in several years, or under certain conditions, and it would be interesting for any one who had a neighbourly patch to learn the blossoming habits of a dozen marked plants from year to year.

The Rattlesnake Plantains are well established the world over. There are twenty-five species growing in Europe and Asia, and but three in America. They belong to the same group as the Lady's-Tresses and the Twayblades and Helleborine. They are all members of the group to which Darwin devoted so much attention in his work on the "Fertilisation of Orchids by Insects." In referring to him we do not find the name Peramium in his index, and must turn to the old familiar name Goodyera, by which these orchids are even better known than by their common American name of Rattlesnake Plantains. Goodyera was the name given to them in honour of the botanist Goodyer by Robert Braun in the year 1813, Kew publication; but one year earlier, in 1812, Salisbury had published their name in the *Transactions of the Horticultural Society* as Peramium. So, obeying the accepted law of priority, we must translate all of Darwin's references to Goodyera into Peramium.

The flowers grow in a bracted spike. Each flower has a broad and round-cheeked appearance, with less effect of the hanging inviting lip than is usual in orchids. The two

sepals at the side spread out widely, but the third and upper one is united with the petals to form a hood. The lip is rounded without being notched, and curves up into a little sac with outspread edges that give a visiting insect a threshold to stand upon.

By cutting a blossom through longitudinally, as Mr. Gibson has done in his sketch, one can follow the steps by which the insects forces its way in, and becomes fertilised with pollen.

The column, that is, the combination of stigma and anther, is peculiarly constructed.

The stigma has a sticky minutely toothed surface (Plate XLIV., Fig. 4). The incurved lip, with its reflexed edges, almost closes the throat of the flower (Figs. 1, 2 and 3). Above the stigma the column projects up into a little arm that holds the anther, and out on either side like wings. This places the anther in such a position that there is a little cup-shaped cavity behind it. Under the broad anther lie two pollen masses, united at their base to a common viscid gland (Figs. 3, 4). The back or upper surface of this anther, called the rostellum, comes off easily like a shield, and to it adhere the pollen masses. The pollen grains cohere in little packets (Fig. 5), as in orchis, and these packets are tied together by strong elastic threads, which, under a powerful microscope, may be made out—at first individually and then running together into a single brown elastic ribbon, by which the pollen masses are fastened to the shield or removable portion of the rostellum.

Both Darwin and Asa Gray have described the visits of the bumblebees to these plants. Inside the curved cup of the lip (Fig. 3) lies the nectar, and in the young freshly opened blossom the column is bent forward so that the tip of the disc and of the anther are bowed down close above the lip. The aperture is so narrow that when a bee's tongue is thrust through to seek the nectar it must invariably pass the tip of the disc or shield. When the bee withdraws his tongue the membrane covering the gland at the base of the pollen masses is ruptured, and the viscid gland is exposed. Thus by reason of its stickiness it adheres to the bee's tongue and the pollen masses are withdrawn from their pockets.

It would seem that in his next visit the bee would land these pollen masses quite ineffectually on the back of the rostellum. But by observing various flowers on the same spike, one will see that the older flowers are more widely open in the throat, and that the whole column is turned somewhat upward and backward, and that the space is quite wide enough to let the bee's tongue, all pollen laden, enter the nectar cup, and in so doing smear the under side of the stigma with its burden.

The general construction of the column and the threads binding the pollen masses interested Darwin greatly, for he finds in the Goodyera (Peramium) a similarity to several other groups of orchids which lead him to state that "Goodyera probably shows us the state of the organs in a group

of orchids now mostly extinct, but the parents of many living descendants."

There are about twenty-five species widely distributed in temperate and tropical regions.

KEY TO THE SPECIES OF PERAMIUM

| | |
|---|---|
| Spike one-sided, plant small, five to ten inches high, leaves ovate. | 1. Lesser Rattlesnake Plantain. |
| Spike not one-sided. | |
| Plant six to twenty inches tall, leaves very strongly netted with white, the tip of the lip short and curved in. | 2. Downy Rattlesnake Plantain. |
| Plant eight to fifteen inches high, leaves not so strongly netted or blotched with white; lip swollen at the base, with a long tip. | 3. Menzies' Rattlesnake Plantain. |

### 1. LESSER RATTLESNAKE PLANTAIN

*Peramium repens* (L.) Salisb. (Plate XLV.)

This species is the smallest of the three Rattlesnake Plantains familiar to us. It grows from five to ten inches in height. The significance of its Latin name as well as its habit would warrant us in calling it the Creeping Rattlesnake Plantain. Its ovate leaves, though strongly marked, blotched with white or with yellow netted veins, do not grow in such a decided tuft as in the Downy Rattlesnake Plantain, but have a tendency to lie along the ground before the scape rises erect. The leaves are an inch or more in length and half as wide, being distinctly pointed. They clasp

the stem with a short petiole, at a slight distance from one another, instead of all rising from the base. The scape is slight, downy, and has small scales which pass into bracts below each flower.

The characteristic sign is that the flower spike is one-sided. It is short and bears in a row small greenish white flowers about a quarter of an inch long. The lip is rounded into a little honey sac, with a narrow apex. Darwin has observed that it, as well as *Peramium pubescens*, is fertilised by bees in the manner just described.

The species grows in woods all over our continent, as well as in Europe and Asia. It is as familiar in Nova Scotia as in Florida and Colorado, and it has been thought to grow as far north as Alaska. It grows at an altitude of 5,000 feet in Virginia. It blooms in July and August.

### 2. DOWNY RATTLESNAKE PLANTAIN

*Peramium pubescens* (Willd.) MacM. (Plate XLVI., Fig. 1.)

THERE has always been a tendency among superstitious folk to associate any natural object that resembled a part of the body with a cure for disease of that organ. The leaves of hepatica, because they were liver-shaped, were supposed to be good for liver complaint, and this beautiful little spring flower has been almost exterminated in this country by a patent-medicine company that some years ago used its leaves as one of its ingredients. The well-known lichen *Sticta pulmonaria* was so called because its follicled and

XLV. Lesser Rattlesnake Plantain

XLVI

Fig. 1. Downy Rattlesnake Plantain. Fig. 2. Individual blossoms of Downy Rattlesnake Plantain. Fig. 3. Individual blossom of Menzies's Rattlesnake Plantain.

pitted surface was thought to resemble the surface of the lungs. Consequently it was used as a cure for consumption. It is probably by the same law of the healing power of resemblances that the Indians fancied that the mottled snake-striped leaves of this orchid were good for rattlesnake bites. Captain Carver said that they "were so convinced of its power as an antidote that they would allow a snake to drive its fangs into them, and chew the leaves and apply them to the wound." Pursh says it has a wide-spread reputation as an infallible cure for hydrophobia, and a New England divine tells us that the leaves of Rattlesnake Plantain were used by the country folk to make a decoction to cure skin diseases.

In 1672, Josselyn mentions the plant in a book called "New England's Rarities." But he called it a Pyrola. There can be no mistaking his quaint language-painting of the leaves, "the Ground whereof is a sap Green, embroydered (as it were) with many pale yellow Ribs."

The difference between the leaves of the Downy Rattlesnake Plantain and the Lesser is distinct enough to be seen at a glance when the plants grow near each other in the woods. The Downy species is more blue-green and its leaves are more silvery, while the leaves of the Creeping species have more yellow in the ground and veining.

The leaves are also larger than in preceding species, being from one to two inches long, oval or ovate. They narrow into clasping petioles and lie in a neat tufted rosette, from the centre of which the flower scape rises.

The chief characteristic of this species is the thick down upon the flower scape. The scape grows from six to twenty inches in height and bears a cluster of small greenish white pouched flowers. They are barely a quarter of an inch long; but with a magnifying glass one can see the ovate lateral sepals, the honey sac of the full lip whose edge is not recurved in this species, and also the tiny column with its sticky stigma on the under side of the shelf and the projecting anther above it.

The Downy Rattlesnake Plantain is an inhabitant of dry woods from Newfoundland to Ontario and Minnesota. Its habitat extends as far south as Florida and Tennessee. It is found at an altitude of 4,000 feet in the mountains of North Carolina. It blooms in July and August.

### 3. MENZIES' RATTLESNAKE PLANTAIN

*Peramium Menziesii* (Lindl.), Morong. (Plate XLVI., Fig. 3.)

THIS Rattlesnake Plantain was named after the explorer Menzies, and is not common enough in the East to be mistaken for the more familiar species. It grows in Canada from Quebec to British Columbia, and was first added to the New England flora by Miss Furbish, who found it in the extreme north of Maine.

It is now reported from various woodland places in New Hampshire, New York, Minnesota, Arizona and California. There the sequoia make dark carpets for its mats of leaves,

as do our hemlocks and pines for the familiar tufts of the Downy and Lesser species of the East.

The flower scape, which appears in August, looks so much like a stalk of Lady's-Tresses that the very eminent Hooker described it in 1839 as *Spiranthes decipiens* (Spiranthes being the old Latin name of the Lady's-Tresses, that has now given way to the older Greek name Gyrostachis).

The plant is rather stouter and stiffer than either of the other species, but has a fleshy creeping root stalk, provided with thick fibrous roots. It has a downy stalk with bracts, but the down is less marked than in the preceding species. The distinguishing features lie in the leaves and lip of the flower. The leaves are a little larger than in the other species, sometimes being two and one-half inches long; they are sharp pointed at both ends instead of being ovate. They are not nearly so prominently veined as in the other Rattlesnake Plantains. Asa Gray notes that the network effect is sometimes entirely wanting.

The flower spike is not one-sided, as in the Creeping Rattlesnake Plantain, and the lip of the flower is not rounded into a sac-like pouch, as in both the other species. It is a little swollen at the base and has a long, narrow, recurved point, which offers a white channel to the insect's tongue. In the centre of the flower, which like the others is almost a quarter of an inch long, the anther may be seen projecting from the end of the column like a little beak. This species blooms in August.

# X

## ACHROANTHES

### ADDER'S-MOUTH. (Plate XLVII.)

AMONG the tiny things that grow close to Mother Earth and bloom in July when summer is at its height, are two very small orchids, whose characteristic sign is a single leaf clasping the stem a little way from the ground, and a stalk of feathery white or green flowers.

This genus was known formerly as Microstylis or Adder's-mouth, and as such many a schoolboy has analysed it. Now the older name Achroanthes, which being translated from the Greek would mean "colourless flowers," must become familiar to old orchid hunters.

There are about forty species of Adder's-mouth known to botanists and six in North America; but of these only two grow in our northern and eastern limits. These have a solid bulb for a root, a slender stem a few inches high, on which is poised the single leaf, and which is sheathed at the base by several scales. The flowers are very small, white in one species and green in the other. They grow in a terminal raceme, and although there is neither odour nor colour to attract visits of insects or admiration from men, yet they are by no means unattended by the former, and they never fail to cause

an exclamation of delight from flower lovers, so daintily poised and delicately crisp is the fresh, erect little plant in either species.

The sepals of the two species are long and strap shaped, though their length is so small as to be almost infinitesimal; two of the petals are mere threads, and in the third, the lip is more expanded. All are fresh and dainty and invite tiny insects to come to their aid in transferring their pollen masses from one flower to another.

These pollen masses are four in number, two lying in each sac, the pairs cohering at their summit (Plate XLVII., Fig. 3).

No one has really studied our American species in the true Darwinian painstaking manner. But it would be an interesting occupation for some modern Thoreau who loved camping in wet woods, or near a swamp, to set up a microscope in a small hut, and find out the nature of the small flies and insects that haunt these tiny orchids.

He would doubtless find the structure somewhat the same as in an Indian form of Adder's-mouth which was sent to Darwin by Dr. Hooker from Kew. In this he found in a young bud a minute regular tongue-shaped projection on the crest of the rostellum, formed of cells, which when slightly disturbed resolved themselves into a drop of viscid matter.

This drop of viscid matter probably attaches the end of the pair of pollen masses to the head of the insect that enters the flower, but exactly how we cannot tell, until some one has either moved a patch of Adder's-mouth from its

swamp to his study table or moved himself and his microscope to their neighbourhood.

That the flowers are perfectly adapted to their insect visitors is evident from the fact that as soon as a flower withers on the stalk its ripened ovary begins to swell into an ovoid, almost round, beakless capsule.

KEY TO THE SPECIES OF ACHROANTHES

| | |
|---|---|
| Leaf sheathing the base of the stem, flowers whitish. | 1. White Adder's-mouth. |
| Leaf clasping the stem near the middle, flowers greenish. | 2. Green Adder's-mouth. |

### 1. WHITE ADDER'S-MOUTH

*Achroanthes monophylla* (L.) Greene. (Plate XLVII., Fig. 1.)

Our two species of Adder's-mouth bear scientific names, having exactly the same meaning. *Monophylla* is the Greek version, and *Uniflora* the Latin, for "one leaf." Therefore, no distinction is carried either in the specific name, which is meant to be descriptive, or in the leaf itself, except that in the White Adder's-mouth species the leaf clasps the stem near the root, and in the Green Adder's-mouth it stands jauntily off at an oblique angle, almost half way up the stalk. The White Adder's-mouth is a very tiny plant, often not more than four inches high, never more than six. The leaf is oval, and from one to two inches long. The raceme, which may be from one to three inches in length, is not a half-inch thick. This indicates how minute must be the flowers that stand erect on either side, on tiny

1

3

2

XLVII

**Fig. 1.** White Adder's-mouth. **Fig. 2.** Green Adder's-mouth. **Fig. 3.** Characteristic pair of pollen masses.

pedicels. In fact they are so very small that they are often not more than a twelfth of an inch in length.

The only petal really distinguishable to the naked eye is the lip that is pointed heart shaped, with saw-toothed sides.

In spite of their minuteness they form a most airy, graceful, feathery white spike, which, rising above the crisp veined leaf, makes a very exquisite and fairy-like plant.

This White Adder's-mouth grows in very damp woods from Quebec to Minnesota, and from Pennsylvania to Nebraska, and blooms in July.

### 2. GREEN ADDER'S-MOUTH

*Achroanthes unifolia* (Michx.) Raf. (Plate XLVII., Fig. 2.)

THE Green Adder's-mouth has a glabrous striped stem, which grows from four to ten inches in height and which bears its one shining green oval leaf about half way up the stem.

The character of the raceme is quite distinct from that of the White Adder's-mouth. It is often an inch thick, and about three inches long, and composed of slender greenish flowers standing off obliquely on slender spreading pedicels.

The sepals are narrow and oblong, and the two lateral petals as narrow as threads. The lip is broad and three parted, without any decided marking, but sufficiently distinct from the sharp-pointed tip of the heart-shaped lip of the White Adder's-mouth to distinguish the one species from the other.

This species has a very wide range, extending from Newfoundland to Ontario and Minnesota, south to Florida, Alabama and Missouri. It is found at an altitude of 4,000 feet in the mountains of North Carolina. It blooms through July.

A curious little note by Baldwin in his "Orchids of New England" offers a suggestion for observation. He says that it was observed by a naturalist of Ottawa, Canada, that in 1882 the Green Adder's-mouth was very common in that region, while few specimens of the White Adder's-mouth could be found. In 1883 the reverse was the case. The White was abundant, and only one or two plants of the other species noted. He adds that "This habit of appearing and disappearing without apparent reason is another charm of the Orchis family."

# XI

## LEPTORCHIS

### TWAYBLADE

THERE is still another genus to which the popular name Twayblade, or Two-leaf, is given. It is the genus familiarly known to orchid hunters in the days before the new nomenclature, as Liparis. The older Greek name Leptorchis means a slender orchis.

The characteristic sign of our species is a pair of oval shining leaves, which rise from the root, clasping the stem. They are larger than the leaves of the other Twayblades in the genus Listera and could not be mistaken for them, as in that genus they are born half way up the stem, and at right angles to it, while in this they form large loose sheaths at the stem's base.

The root is a round, solid bulb, with a few fibres attached. It sends off a large offshoot which is the bud of a new plant.

The effect of the plant is of a crisp, stiff, rather coarse little herb, with yellowish green flowers, whose real beauty does not strike the observer until he has examined it with the magnifying glass. Then he will find a slender flower whose sepals and petals are nearly all reduced to narrow straps or

threads. They are all of about equal length, but stand off from each other with such strong curves that the flowers, according to one author, "have a combative air like so many little dragons." Darwin does not describe the structure of the Liparis nor speak of the insects that fertilise it, but he describes a few of the great exotic tribe Malaxeæ, "which ornament in so wonderful a manner the tropical forests." Allied to them are the Adder's-mouths and Twayblades, which are among the most insignificant of the orchids in our woods.

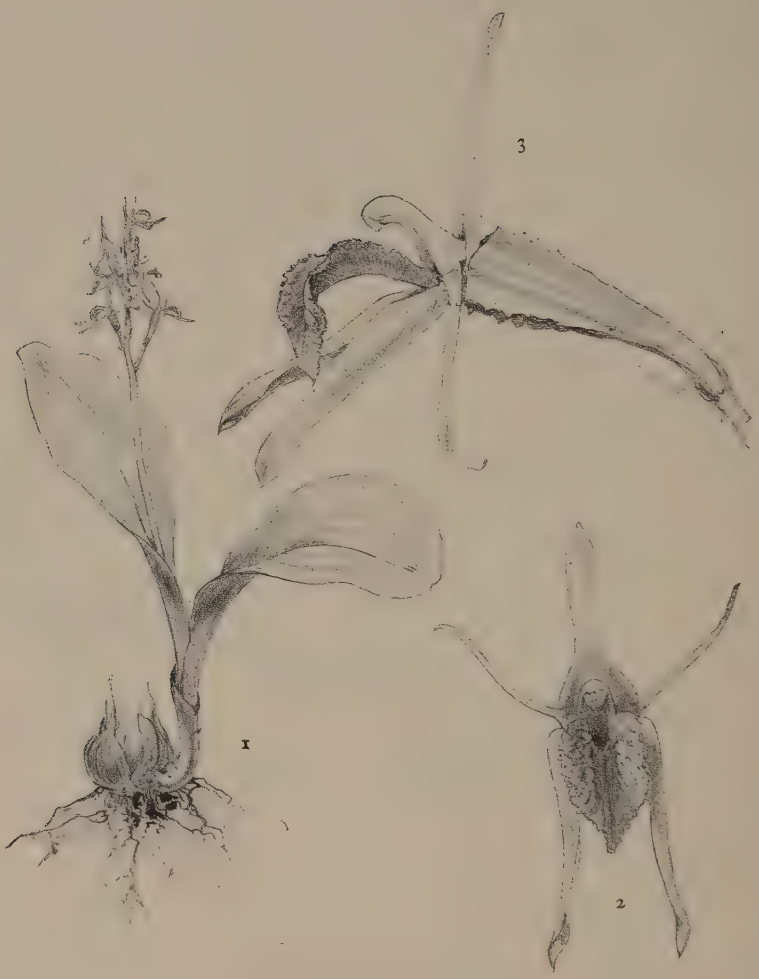
A characteristic of this tribe is that the pollen grains cohere in large waxy masses, and are not often furnished with caudicles or bound with threads.

In this particular genus there are four pollen masses, two in each cell tucked into the anther that is attached to the end of the elongated incurved column.

Although no one has written for public print just how fertilisation has taken place, yet Mr. Gibson's sketch of the parts of the flower (Plate XLVIII., Fig. 3) is so clear that if, with the structure clearly in mind, one could go to some damp dell and watch a few of these plants for an hour or two, one might see exactly how fertilisation is effected. As the flower stands poised on its stalk, one of the several in the raceme, the greenish yellow petals and sepals radiate star fashion with curved tips around the column. The lateral petals are narrow as threads, and the broader lip is raised alluringly. It has a nectar-secreting groove or furrow down its median line, and the edges are incurved to make a

XLVIII. Large Twayblade

Fig. 1. Natural size. Fig. 2. Flower raceme, enlarged. Fig. 3. Single blossom, very much enlarged.




XLIX. Loesel's Twayblade

Fig. 1. Natural size. Figs. 2 and 3. Single flower, magnified.

channel which guides the insect to the curved and capped column. That little projective cap on the anther would, we think, be easily knocked off by a fly backing away and flying upward from his feast, and if it exudes when touched a viscid drop, as do other of the twayblade, the pollen masses would be drawn out and would stick fast to the insect's head.

This is a genus worth knowing and watching, for it gives an opportunity for original observation.

There are about one hundred species of Leptorchis growing in temperate and tropical regions, but only two are found in the Northern and Eastern States.

KEY TO THE SPECIES OF LEPTORCHIS

| | |
|---|---|
| Raceme many flowered, lip as long as the petals. | 1. Large Twayblade. |
| Raceme few flowered, lip shorter than the petals. | 2. Loesel's Twayblade. |

### 1. LARGE TWAYBLADE

*Leptorchis liliifolia* (L.) Kuntze. (Plate XLVIII.)

The Lily-leafed Twayblade is the translated common name that is more often given to this species than the name Large Twayblade. It is only large when near its smaller relative. Its stem varies from four to ten inches in height. The two oval ribbed leaves rise from the bulb, sheathing the stem loosely.

The raceme is sometimes six inches long and with a great many flowers for so small a plant. They stand well off

from the stalk on pedicels fully half an inch long, so that each flower with its curved thread-like side petals, and broad, striped incurved lip, stands out distinctly and independently, working a very striking effect for so small and pale a plant.

The fruit is a ribbed club-shaped capsule on a thickened pedicel. As these capsules stand erect upon the stalk they present a totally different appearance from the other Twayblades of the genus Listera, where the ovoid capsules are pendent on the stalk.

The Large, or Lily-leafed Twayblade blooms from May to July, according to the locality. It ranges from Georgia and Missouri to Maine and Minnesota, and ascends to 3,000 feet in Virginia.

### 2. FEN ORCHIS, OR LOESEL'S TWAYBLADE

*Leptorchis Loeselii* (L.) MacM. (Plate XLIX.)

This Twayblade has a strongly ribbed scape rising from two to eight inches in height and clasped by a pair of pointed elliptical leaves which are sometimes six inches long. The raceme bears only a few greenish flowers which are smaller than in the other species. The sepals are narrowly lanceolate and spreading. The petals are linear and curved backward, while the wavy, minutely scalloped lip is curved down and under, forming a threshold for the insect to cling to and clamber up.

The sharp angles of the ovary, with its jagged ribs and

the dotted and mottled marking of the lip is a distinctive feature of this species.

It has a more northern habitat than the preceding Twayblade. It loves wet woodlands or banks where springs abound and thus deserves its name Fen Twayblade. It grows in Nova Scotia and across the continent to the Northwest Territory. Its furthest southern limit is Maryland and Missouri. It blooms from May to July.

## XII

## CALYPSO

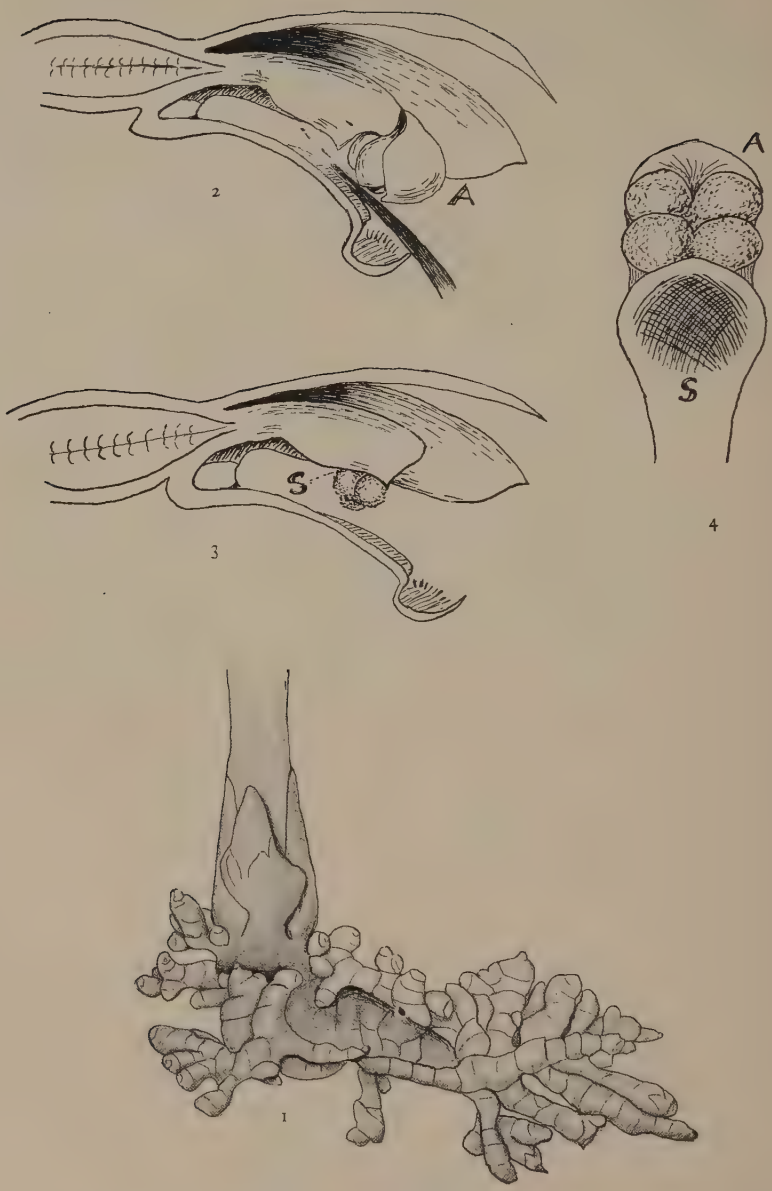
*Calypso bulbosa* (L.) Oakes. (Plate L.)

In the East Indies there is a group of orchids, warmth loving and beautiful, of which one species has wandered over straits that were once connecting lands to the far hills of our north country and has made its home under the pines and damp crags, and in the cold wet woods of the mountains.

It is *Calypso bulbosa*. Its specific name used to be *Calypso borealis*, which meant "Nymph of the North," for the flower was dedicated to the goddess Calypso. It is a poetic grief to those who loved this exquisite little brilliant blossom, that its bulbous root must be the excuse for its revised cognomen, instead of that far North where it has journeyed to bring the luxuriant touch of the South to the summer.

When Linnæus found the blossom in the cold woods of his beloved Sweden he gave it the name *Cypripedium boreale* because its shoe-like pouch looked much like that of the Lady's-Slipper. But he did not appreciate the finer points of mechanism by which the orchids are now classified according to the structure of their stigma and stamens. Modern

L. Calypso




LI. Corallorhiza

Fig. 1. Root. Fig. 2. Blossom cut lengthwise, showing curved column and anther. Fig. 3. Blossom, showing pollen masses adhering to the stigma. Fig. 4. Pollen masses lying under anther and above stigma.

classification puts the Calypso in the same general group as the Adder's-mouth and Twayblades.

Although it is common in Oregon and the Northwest it is very rare in New England. As it blooms in May or early June and haunts the cold mountain dampness, it is not apt to be found by the "summer people," who would certainly exterminate it with a rash passion for its loveliness.

The unpoetic manuals describe it as a bog herb, with a solid bulb and coralloid roots, and a showy terminal bracted flower.

But the sunset would need to stock a painter's palette if he would represent the little blossom as it hangs from its jointed stalk, some six inches above the ground. The flowers are purple varied with pink and shading to yellow. Deep purple lines accentuate the colour in the crimson petals, and a brush of yellow woolly hairs bristle up under the column, on the two-pointed yellowish tip of the shoe-like pouch.

Travellers to Labrador and Alaska bring this lovely little orchid home with them, and hunters in Maine see it. It is also found growing in the black soil of the arbor-vitæ swamps in Vermont.

All its nearest of kin, belonging to the genus Cælogyne, live in the East Indies; but this one lone northern nymph has strayed through northern Europe and found homes in Lapland and Russia, as well as in our northern countries. It has been found in Canada "on a high limestone ridge, . . . sparsely covered with white pines in holes, caused

by tearing up of the roots and superincumbent earth when fresh trees are uprooted by storms."

The place to look for it is in the primeval forest in Maine, where the groves of fallen trees are wreathed with Twin-flowers and Snowberry vines, where in the cold silence of early summer it springs with its pointed heart-shaped leaf from its little ivory bulb into radiant blossom in the evergreen shade.

## XIII

## CORALLORHIZA

CORALROOT. (Plate LI.)

Does every family have its degenerate members? In the social world degeneration seems to mean the ability to do without something that has grown to be a necessity to everybody else. To do without clothes, or cooked food, or manners, would imply some kind of degeneration, although the individual that had reverted to such aboriginal habits might be a very well-developed specimen of humanity. Possibly the orchids, if they could grasp their relation to each other, would class the Coralroots as the degenerates of their family, for the reason that they do without leaves. Certainly leaves seem to be essential to every well-regulated plant, as clothes to a human being; but in the woods that are glorified by the Cypripedium and Habenaria we come upon a leafless, greenless, uncanny plant that lives the life of a beggar, and yet is proud withal, for it has its spotted banner and its insect servitors, and it keeps up the family traditions in every way except that it has no chlorophyl.

Possibly chlorophyl, the green-making granules that crowd the cells of the leaf and stem, bears the same relation to the flower world as does the gold that circulates in the

human world. Certainly it is the transmuting element. It is through the chlorophyl grains that the crude elements of the soil and air are transformed into flowers and seed, as in the world of men it is the power of gold that transforms the crude elements of the earth into palaces and luxuries. Possibly the plant that is poor in chlorophyl has sunk lower and lower through generations till it is reduced to the condition of living on others; and could not adapt itself to the forming of its own chlorophyl any more than a beggar could to the earning of money. Some such plants live on the sap of others, as do the dodder and mistletoe, fastening suckers into their living cells and drawing out the fresh juices that are destined for the plant's own use, until they kill it, when they die with their host; but others called saprophytes live more as beggars do, on the refuse of other plants; on dead or dying wood underground.

The Coralroots are saprophytes or root parasites. Sometimes in burrowing among the mosses and liverworts of an Adirondack swamp, one will uproot a bunch of pinkish-brown coral, and then looking for the plant will find a thin brownish-purple stem with apparently a few withered seed vessels on it. This is all there is of the Coralroot's stalk and flower.

It was from the coral-like, bunchy, knobby, twisted root-stocks that suck a scanty existence from other roots and buried things that Linnæus gave this group of orchids the name Corallorhiza (Plate LI., Fig. 1). The root is always hard to dig up, it is buried so low between roots and under

stones; but when found and washed it is a most interesting object, especially when one realises that in its knobby warts there is some chemical power different from that of all other plants, except such as the Indian Pipe and Broom-rape, chemical differences that send wise men to their laboratories to experiment, and philosophers to their studies to wonder why in all this world whose natural laws are so wonderful, a little group of plants should live so unnaturally and yet have adapted themselves so comfortably to their limitations.

But on the other hand, if the orchids were able to discuss values, they might possibly place the Corallorhiza higher in the social scale, as the Hindoos would reverence a priest with his begging bowl, where we would see only the exponent of a parasitic system. For the orchids that grace the green-houses, those snared like flaming birds from the tops of tropical trees, have all some mysterious power of drawing their nourishment from the air and moisture through the apparent medium of a little bark, or moss; so it may be the creed of these spirit flowers that they should be served rather than serve themselves, and that to delve in mud for their food is unworthy of their kind, and our thrifty Habenarias and Cypripediums that thrust ordinary roots in moist black soil may be thought as much unclassed as a Buddhist who should drive a trade for money.

Therefore it may be that the Corallorhizas who do not work for their own living are after all more closely connected with the gorgeous orchids that do not come into con-

tact with the elements of the soil; and the leafy rooted orchids may be the degenerate children of Namon, thrust out from the aristocracy.

Be it as it may, the Coralroots afford a chance for study in the new field of chemical reaction, and will some day forge a link in the vast chain of knowledge of the relationship between the organic and inorganic world.

There is, however, something a little uncanny about the Coralroot flowers. Walking through a thick, rich wood over beds of brown leaves, one is suddenly aware of slender purple streaks piercing the dead leaves. On stooping to examine them one sees that they shade through brown and purple to a light, clear green and that they are furnished with a raceme with tiny flowers standing off stiffly and sparsely at an oblique angle or hung with little drooping green cucumbers for seed capsules. One sees another, and another, till suddenly, as if one were made aware of the presence of spirits, one sees that the hillside is so thick with them that if their flowers were, for instance, like those of the Purple-fringed Orchid, the woods would be one sheet of violet flame.

Close to the stem is pressed a purple scale or two, the rudiments of the leaves that bear no green and lend no service to the plant nourishment.

All five familiar Eastern plants look much alike, save for some detail of size or form of lip. It requires a stretch of the imagination to consider the small brownish-purple wisps of flowers upon their bare stalk, beautiful. The pendent greenish capsules, like fairy cucumbers, that ripen

from the twisted ovaries after the blossoms are gone, are more attractive. But with a good magnifying glass the flowers of the Coralroot show spots and ridges, a notched lip and a curved column, where stigma and stamens are combined in a mechanism as interesting as in any of the orchids, to protect first and then to distribute the pollen.

In all our species the sepals and petals are about the same length; but in none except *Corallorhiza multiflora* is there any spur manifest. In the others there is a short sac that adheres to the ovary like a little ridge at the point where the spur usually swings free. Inside of the minute flower a magnifying glass shows a column that lies nearly free from the flower, and that is slightly incurved (Plate LI., Fig. 2). The anther lies at the end of the column and has a lid which claps close over the pollen grains, as the insect thrusts its tongue down the very small narrow throat of a blossom, but the slightest touch as of the drawing back of the insect's tongue snaps it back and often knocks it off, and out fall four soft, waxy pollen masses, in two pairs (Plate LI., Fig. 4).

On the under surface of the column the stigma lies in a slightly hollowed place (Plate LI., Fig. 3), and there the pollen is deposited as the insect flies to the first more mature and more widely opened flower. The transferring of the pollen is due to its own powdery, waxy quality. There are no stalks with adhesive discs as in the Habenaria, and no connecting tissue. But the work of fertilisation seems to be thoroughly carried on. Mr. Gibson examined four plants in blossom and found that the lid that protects the pollen

masses had been carried off in every open flower, and was present only in one bud left unopened, while on the under curve of the uncapped column, where the stigma lies, there was dry pollen adhering and turning blackish. While as a further proof that the work of cross fertilisation is thoroughly carried on, one finds the little twisted green capsules drooping in regular order adown the stalk, after the flowers have blossomed.

There are about fifteen species of Corallorhiza distributed all through the north temperate zone. In addition to the following some four others occur in the southern and western parts of North America. The cutting of the lip of these small flowers, and the presence or absence of a little sac-like protuberance in place of a spur, are the characteristic signs of the different species.

KEY TO THE SPECIES OF CORALLORHIZA

| | |
|---|---|
| A small, sac-like spur growing to the top of the ovary. | |
| Lip two-toothed or two-lobed near the base, flowers hanging down on raceme. | 1. Early Coralroot. |
| Lip entire, not notched at end, flowers very small. | 2. Small-flowered Coralroot. |
| Lip entire, notched at end, flowers more than half-inch long, erect. | 3. Wister's Coralroot. |
| Lip deeply three-lobed, flowers three-quarters of an inch long, erect. | 4. Large Coralroot. |
| No spur, ovary smooth, flowers striped with purple. | 5. Striped Coralroot. |

LII

Fig. 1. Early Coralroot. Fig. 2. Large Coralroot.

1

2

LIII

Fig. 1. Wister's Coralroot. Fig. 2. Small-flowered Coralroot.

### I. THE EARLY CORALROOT

*Corallorhiza Corallorhiza* (L.) Karst. (Plate LII., Fig. 1.)

THE Early Coralroot has a smooth, naked stem growing from four to twelve inches in height. Several close sheathing bracts clasp the stem at the base, and at its summit the half-inch dull, dingy purple blossoms hang in a raceme from one to three inches in length. The pedicels on which the flowers hang are so short as to make them appear sessile, and the bracts below them are so small as to be almost invisible. The early time of blooming, May and June, the shortness of the pedicels, and the drooping habit of the flowers on the raceme are the characteristic sign by which this Coralroot may be known from the others that so closely resemble it. It grows in swampy places and is often found as a near neighbour of Calypso, but it is rather rare, though it has a wide range, being found as far north as Nova Scotia and Alaska, and as far south as the mountains in Georgia. It can stand the coolness of 3,000 feet altitude in Vermont, and it grows in Europe. It would appear from such a widely scattered habitat that it must once have been a common plant, and that the conditions that serve it now hardly well enough to keep it in existence among its leafy neighbours, were once sufficient to its needs.

The sepals and petals are about quarter of an inch long. The lip is shorter than the petals, and is whitish. It has two minute notches at the end (Plate LIV., Fig. 1).

There is no true spur, but a sac or protuberance joined to the tip of the ovary.

### 2. SMALL-FLOWERED CORALROOT

*Corallorhiza odontorhiza* (Willd.) Nutt. (Plate LIII., Fig. 2.)

THE slender purplish scape of this, perhaps the most insignificant of all our orchids, is from six to fifteen inches high and has from six to twenty minute flowers. They are seldom more than a quarter of an inch in length, but under the magnifying glass they show as bravely as do some of the Habenarias. The lip, which is not more than two lines long, is slightly notched or toothed upon its broadly ovate edge. It is whitish and is marked with purple lines converging toward the throat and ornamented with a few spots.

The smallness of the flowers and their distinct pedicels, as well as the bracts that are visible beneath them, distinguish this Coralroot from the Early Coralroot, and the drooping habit of the flowers in the raceme distinguish it from all others whose flowers stand erect.

It grows in woods from Massachusetts to Michigan, and is found in Florida. It reaches the 3,000-foot level in North Carolina. It blooms in July and September.

### 3. WISTER'S CORALROOT

*Corallorhiza Wisteriana* Conrad. (Plate LIII., Fig. 1.)

THIS Coralroot, described by Conrad in the *Journal* of the Academy in Philadelphia, in the year 1829, must be distinctly American.

It is stouter and taller than the Small Coralroot, growing as high as sixteen inches, though usually shorter. It has a loose raceme from two to five inches long, bearing tubular flowers nearly three-quarters of an inch long. They stand erect on slender pedicels, but when the capsules are ripe they droop. The lip is the characteristic sign; it widens from a narrow claw at the throat to a broad oval (Plate LIV., Fig. 2). It has a slightly wavy margin and a notch at the apex. Two short, sharp, high ridges converge toward the throat. The drooping capsule is nearly half an inch long when ripe.

In Florida and Texas this Coralroot begins to bloom in the woods in February and follows the spring north to Massachusetts and Ohio, where it blooms in May.

### 4. LARGE CORALROOT

*Corallorhiza multiflora* Nutt. (Plate LII., Fig. 2, LIV., Fig. 3.)

THE characteristic of this species is that it possesses a little more of everything than its kindred—more flowers, as its name indicates; more inches of height, eight to twenty; a longer raceme, two to eight inches, and more elaborately marked flowers. It is really beautiful in its variations of colours. It shades from brown to purple, from purple to pink, and has a touch of white on the spotted purple-lined lip, and of yellow on the spur. The absence of all green and the soft blending of other colours make it noticeable, and it is

not as apt to be overlooked or mistaken for a naked stalk of seed pods as some of the smaller Coralroots.

The flowers grow stiffly erect on the scape, but droop on lengthened pedicels in fruit.

The petals of this species are narrow and about a quarter of an inch long and somewhat spotted. The lip with its alluring spots has a peculiar shape. It is oval in general outline, but is three lobed. At the upper part there is a deep constriction that gives the effect of a pair of rings. Often there is another hour-glass constriction on the lower portion. At the throat above the spots are two distant ridges which undoubtedly guide the insect's tongue to its destruction.

The knob on the ovary that serves for a spur is quite distinct in this species and makes one wonder whether in the course of gradual development the Coralroots began to evolve a spur, and finally some more perfectly adapted species was developed that carried it to perfection, as in the Habenarias, or whether the knob or wart pressed close to the ovary is a survival of a once more perfectly developed spur with a honey sac. The lack of leaves and the general degenerate character of the Coralroots seem to indicate that the spur is a survival rather than a forerunner of spurred flowers.

The Large Coralroot is found in the woods of the Northern States. It extends as far north as Nova Scotia and British Columbia. It grows in Florida, Missouri, Washington State and California; and the explorers of the 40th

parallel reported it in one locality at an altitude of 7,000 feet. Its wide-spread habitat shows that it has held its own in spite of its leafless condition. Doubtless its every attraction of spur and spots and stripes serves to make it the most conspicuous and the best adapted of its kind, hence from July until September it may be found rather commonly in woods from one coast of the continent to the other.

### 5. STRIPED CORALROOT

*Corallorhiza striata* Lindl. (Plate LIV., Fig. 4.)

This Coralroot is also large, growing from eight to twenty inches in height. Its scape is stout and purplish, and it bears from ten to twenty-five flowers on a raceme that grows from two to six inches long.

It is one of the three Coralroots whose flowers grow erect. It may be known by the colour of its flowers, which are of a dingy purple hue streaked with lines of true purple. The individual blossoms are often three-quarters of an inch long, and the spreading lip, that hangs out a little longer than the rest of the blossom, gives it a certain braveness in spite of its sombreness. A distinct bract clasps each sessile ovary, and stands sharply erect, after the fruit ripens, and the elliptical capsule, nearly an inch long, droops on the stalk.

On pulling off the lip of one of these Coralroots and examining it under the microscope, one will see a divided ridge in the throat (Plate LIV., Fig. 4), lying between the

incurved edges of the constricted parts. This must force the insect to a sideways entrance to the flower. There is no spur in this species, and it has not been recorded where the nectar is found, but possibly it lies in a sort of sac-like enlargement of the flower just above the ovary. The Striped Coralroot grows in woods from northern New York to Michigan and is found as far west as Oregon and California. It blooms in July.

LIV

Fig. 1. Characteristic shape of lip of Early Coralroot. Fig. 2. Blossoms, showing lip of Wister's Coralroot. Fig. 3. Front and side view of blossom of large Coralroot. Fig. 4. Lip and capsule of Striped Coralroot (all enlarged).

LV. Tipularia or Crane-fly Orchis

# XIV

# TIPULARIA

CRANE-FLY ORCHIS

*Tipularia unifolia* (Muhl.) B. S. P. (Plate LV.)

One of the rarest orchids that we have in the Eastern United States, and that ranks next to the smaller Pogonia in its scarcity, is the Crane-fly Orchis. Here and there in sandy woods in New England, as far as Michigan and south to Louisiana and Florida, it may occasionally be found. It is a prize to the collector, and its discovery will arouse a train of thought if he be a philosopher, for the specimen that he brings home to his herbarium must be a hardy survivor of a genus that once was scattered widely over the earth. In the Himalayan Mountains there is a species of the Crane-fly Orchis so like this, that its only distinguishing feature is a slight difference in the tip of the leaf. Did this orchis have its day when the continents were so different in outline that they made a continuous garden; and since oceans have rolled between, is it any wonder that the Asiatic brother should be not quite recognisable to its American relations that have almost died out?

Whether the Himalayan Crane-fly Orchis is common and hardy there we cannot say, but for some reason, in this country, this plant, that must once have been common to

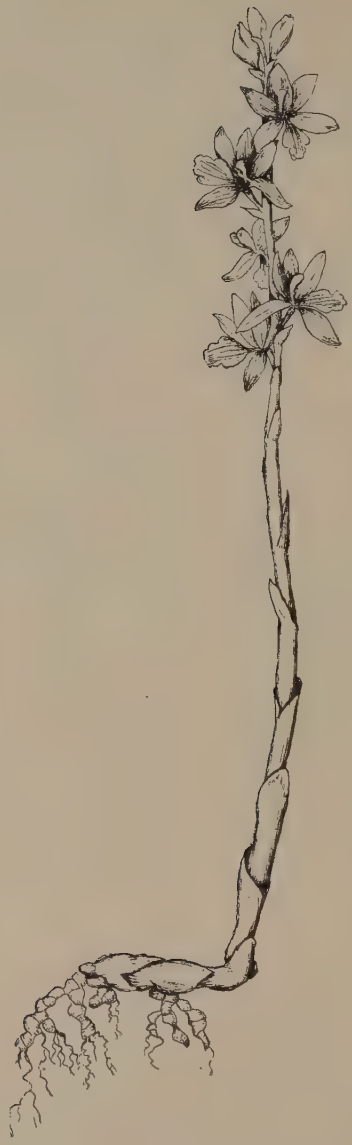
be so widely spread, is not able to cope with competition in the shape of more alluring flowers that attract insects, or else it does not find congenial soil.

The Crane-fly is one of the three American species of orchids that send up a single leaf in the autumn. The other two are Calypso and the Puttyroot. The Crane-fly puts forth a smooth, ovate-pointed, young, reddish-purple leaf about the middle of September. As it attains its full size it turns dark green and frequently lasts through the winter.

The following July the flower scape appears. It springs from the solid bulb or corn that forms the root, and of which several sometimes grow in a cluster. It rises to a height of fifteen or twenty inches, and is flowered along the upper leaf with small half-inch, greenish-purple blossoms borne on long flower stalks. These give the effect of a very loose raceme. There are no bracts at the base of each flower, but the inch-long slender spur, that hangs from the lips, swings between the flowers and takes away that naked look that comes with a flower stalk that has no bracts. The sepals and petals are purplish or brownish, and only a quarter of an inch long, except the narrow lip, which is elongated and three-lobed. The very slender straight or sometimes curved spur is the characteristic sign of this genus, as well as the bright green column that sticks out of the centre of the flower. The anther has a lid under which are two pollen masses, each of which is two-parted, and connected by a linear stalk. The rarity of this flower has given no one an opportunity to see how it is fertilised.

LVI. Limodorum or Calopogon

Fig. 1. Blossoming plant. Fig. 2. Single blossoms.



LVII. Hexalectris or Crested Coralroot

# XV

# LIMODORUM

## GRASS-PINK

*Limodorum tuberosum* L. (Plate LVI.)

The Greek name, which means meadow gift, is appropriate for this brilliant blossom which rises among the tall grasses of wet meadows and bogs over the whole eastern part of the continent. Caiopogon is the name by which it is known to earlier botanists.

It frequents the same haunts as the Rose Pogonia, and in June or July there are few extensive bogs where both do not grow. As Baldwin says, "The more dangerous the morass and the more untrustworthy the scow you have discovered on the shore of a lake or creek, the more confident you may be that your prize is awaiting you."

This is the only species of Limodorum that comes within our eastern limit.

There is one striking feature that distinguishes this orchis from others. The ovary is not twisted as in all our other orchids, consequently the lip is in its proper place and stands erect over the flower instead of hanging from the under side.

The slender grass-like plant rises a foot or a foot and a

half in height from a small white bulb that shines like a tiny egg between its brown sheath. Some long, fleshy rootlets hold it in place, and from under a long brown sheath that sometimes extends for several inches, there springs a bright green leaf, generally long and narrow, with parallel veins. It has a smooth surface and margin, and looks very like a blade of grass.

Below the flower cluster is a smaller pointed bract leaf, and then comes the little spire of blossoms of three to fifteen flowers. The stem ascends in angled joints, each about an inch in length, and from each bend springs one or two blossoms, each an inch long. The blossoms ascend, the lowest withering while the youngest are still in their curved oval buds.

A little green sheath supports each flower. The ovary is slender and ribbed, often slightly curved, but never twisted around. The six oval, pointed, lavender or crimson-purple petals and sepals flutter and curve away from the centre. The lip, reared high, and spotted with white, is scalloped like a standing heart. It bears a brush of orange, rose or yellow bristles that bend toward the column. The incurved column is lavender, and attached under a shelf on its back by a slender thread are two parallel anther sacs. How the insects effect cross fertilisation is yet to be discovered; but to do this a trustworthy punt and a mosquito net, and hours of patience are requisite, for if one removed the Grass-pink from its swampy home, one could never induce the

myriad insects that live in a swamp to accompany it to one's study or garden.

But that the right insects continually serve to transfer its pollen is evident from the fact that on slitting open its oblong, erect capsule one finds it filled with ripened seeds.

## XVI

# HEXALECTRIS

### CRESTED CORALROOT

*Hexalectris aphyllus* (Nutt.) Raf. (Plate LVII.)

The rich Southern woods of North Carolina, Kentucky, Florida, Missouri and northern Mexico have an August-blooming orchis whose root is very like the Coralroots of the genus Corallorhiza. The stout scape of eight to twenty inches height has scales instead of leaves; the upper are sharp pointed and the lower sheathing and blunt.

The raceme bears eight to twelve large flowers, each about an inch long. Their narrow elliptical sepals and petals are brownish purple, striped with deeper purple veins. The spurless lip, broad and three-lobed, has a rounded wavy margin. The few tiny capsules are elliptical and nearly an inch long.

This Coralroot differs structurally from the genus Corallorhiza in many ways, one being that there is not even the rudiment of the spur that in Corallorhiza forms a knob on the ovary. Its leafless and chlorophylless character is physiologically the same as in Corallorhiza, but as the plant is more distinctly Southern it has not received the attention of Eastern botanists, and nothing is known of the structure of its column and of its insect visitors.

LVIII. Aplectrum. Adam-and-Eve or Puttyroot

## XVII

## APLECTRUM

ADAM-AND-EVE. PUTTYROOT

*Aplectrum spicatum* (Walt.) B. S. P. (Plate LVIII.)

The Aplectrum or "Spurless" Orchis, as its Greek name signifies, is one of those plants that has become familiar to the natives of a place because of some useful property. It rises from a solid bulb-like root, like the corm of a crocus. This bulb sends out offsets, each of which takes two years to develop, and dies at the end of the third, so that on digging up a root after the plant has finished flowering in June, there will be found two more bulbs in a straight line connected with the dying one. These two joined bulbs are called "Adam-and-Eve" by the negroes and poor whites in Georgia and the Southern States, where the orchid grows freely. They wear them as amulets, and tell each other's fortunes by placing the separated bulbs in water, and according as "Adam or Eve pops up calculate the chances of retaining a friend's affection, getting work, or living in peace with neighbours."

Pursh says that the name Puttyroot is more widely used in the North, for in olden days it was the custom of thrifty housewives to grind the roots and mix the powder

with water, making a sticky paste with which they were able to mend their broken crockery.

Like *Calypso bulbosa*, this plant begins its cycle of life late in summer or early in September, by sending up from a two-year-old corm a single leaf. "A stiff, dark purple horn first pricks the ground, rises slowly, for it has a long and severe life before it, and when it grudgingly uncurls, shows a coarse leaf, greenish on the upper side, and threaded with numerous white veins. Crushed down and bleached by the snows, it presents itself in the spring in a very wrinkled condition, holding on bravely till the plant flowers, when it withers away."

The leaf is from four to six inches long and from a half-inch to three inches in width, being sometimes elliptical and sometimes ovate in shape.

The smooth flower stalk grows from one to two feet high, bearing two or three scales. A small raceme with several inch-long flowers hanging loosely on short pedicels. It looks rather like a Coralroot, for the narrow flowers are a dull yellowish brown mixed with purple, and are formed of narrow sepals and petals about half an inch long. The lip is shorter than the petals and slightly three-lobed with a wavy margin. It is white, flecked with purple, and free from the slightly curved short column.

The ovoid angled capsules grow to nearly an inch in length and hang upon the flower stalk.

The plant is not uncommon, growing from Ontario to the Northwest Territory and Oregon, south to Georgia,

Missouri and California. It is, however, rare in New England. A Michigan botanist wrote some years ago that it was very abundant near Detroit, but that he had watched some years and had seen no flowers, only buds that had never matured.

Though the flowers have a sweet fragrance, the bulbs have a decidedly unpleasant odour as well as taste.

# INDEX


Aceras Anthropophora, 9.
Achroanthes, 120.
    Key to species, 122.
    monophylla, 122.
    unifolia, 123.
Adam-and-Eve, 151.
Adder's-mouth, 120.
Aerial roots, xiv.
Aplectrum spicatum, 151.
Arethusa, 66.
    bulbosa, 78.
    of Australia, 66.

Baldwin on "The Orchids of New England," vi.
Bog Orchis, Small Northern, 33.
Botanical Club of Am. Assoc. for Advancement of Science, ix.
Botanical Congress, viii.
British bee and foreign orchid, 67.
Britton and Brown's "Illustrated Flora," ix.
Broad-lipped Twayblade, 108.
Burroughs, John, 16.

Calypso bulbosa, 130.
Caterpillar protected by blossom, 54.
Chlorophyl, xiii, 134.
Coralroot, 133.
Corallorhiza, 133.
    Corallorhiza, 139.
    Key to species, 138.
    multiflora, 137, 141.
Corallorhiza
    odontorhiza, 140.
    striata, 143.
    Wisteriana, 140.
Crane-fly Orchis, 145.
Crested coralroot, 150.
    Yellow Orchis, 47.
Cross fertilisation, xviii.
Cypripedia of Europe, 13.
Cypripedium, 3.
    acaule, 10.
    arietinum, 8.
    candidum, 14.
    hirsutum, 15.
    Key to species, 8.
    pubescens, 16.
    reginæ, 11.

Darwin, vi.
Darwin's experiments with gyrostachys, 88.
    observations on Listera, 105.
Dead insects in the blossom, 13.
Downy Rattlesnake Plantain, 116.
Dwarf Orchis, 33.

Early Coralroot, 139.
Epipactis latifolia, 83.
    viridiflora, 82.
Espiritu Santo, 9.

Fen Orchis, 128.
Fragrant Lady's-Tresses, 97.
Fringed Orchis, Large Purple, 56.

Fringed Orchis
Prairie White, 56.
Smaller Purple, 59.
White, 51.
Yellow, 48.
Fringeless Purple Orchis, 63.

Goethe's theory of metamorphosis, xv, 15.
Grass-leaved Lady's-Tresses, 98.
Grass-pink, 147.
Gray, Asa, vi.
Green Adder's-mouth, 123.
Orchis, Tall Leafy, 36.
Wood Orchis, Small, 43.
Grew, Nehemias, xix.
Gyrostachys, 87.
cernua, 95.
Darwin's experiments, 88.
gracilis, 100.
Key to species, 91.
odorata, 97.
plantaginea, 94.
præcox, 98.
Romanzoffiana, 92.
simplex, 99.

Habenaria, 24.
blephariglottis, 51, 56.
bracteata, 42.
chlorantha, 31.
ciliaris, 47, 48, 53.
clavellata, 43.
cristata, 47.
dilatata, 39.
flava, 45.
grandiflora, 57.
Hookeriana, 30.
hyperborea, 36.
integra, 35, 41.
Habenaria, Key to species, 27.
lacera, 54.
leuocophæa, 56.
nivea, 34.
obtusata, 33.
orbiculata, 25, 29, 53.
peramoena, 63.
psycodes, 59.
Heart-leaved Twayblade, 109.
Helleborine, 82.
Hexalectris aphyllus, 150.
Hooded Lady's-Tresses, 92.
Hooker's Orchid, 30, 58.
Humboldt, xii.

"Illustrated Flora," Britton and Brown, ix.
Insect agency, xix.

Lady's-Slipper, 3.
Tresses, 87.
Large Coralroot, 141.
Purple Fringed Orchis, 56.
Round-leaved Orchis, 29.
Yellow Lady's-Slipper, 15.
Twayblade, 127.
Leptorchis, 125.
liliifolia, 127.
Loeselii, 128.
Lesser Rattlesnake Plantain, 115.
Limodorum tuberosum, 147.
Linnæus, viii, xix.
Listera, 103.
convallarioides, 108.
cordata, 109.
Key to species, 107.
Little Lady's-Tresses, 99.
Loesel's Twayblade, 128.
Long-bracted Orchis, 42.

Menzies' Rattlesnake Plantain, 118.
Metamorphosis, Goethe's theory, xv.
Moccasin Flower, 10.
Müller, 17.
Mycological clubs, v.

Night insects, 30.
Nodding Lady's-Tresses, 95.
Pogonia, 72.
Nomenclature, changes in, viii.

Orchis, 19.
Key to species, 20.
spectabilis, 20.

Pale-green Orchis, Small, 45.
Parts of a flower modified leaves, xv.
Peramium, 111.
Key to species, 115.
Menziesii, 118.
pubescens, 116.
repens, 115.
Pink Lady's Slipper, 10.
Pogonia, 65.
affinis, 76.
divaricata, 73.
Key to species, 69.
ophioglossoides, 69.
trianthophora, 72.
verticillata, 74.
Prairie White Fringed Orchis, 56.
Purple Fringed Orchis, Large, 56.
Smaller, 59.
Puttyroot, 151.

Ragged Orchis, 54.
Ram's-head Lady's-Slipper, 8.
Rattlesnake Plantain, 111.
Reproductive organs, xvii.
Rose Pogonia, 69.
Round-leaved Orchis, Large, 29.
Small, 23.

"Sabot de la Vièrge," 17.
Saprophytes, 134.
Self fertilisation, 38, 68.
Showy Lady's-Slipper, 11.
Orchis, 20.
Slender Lady's-Tresses, 100.
Small-flowered coralroot, 140.
Green Wood Orchis, 43.
Northern Bog Orchis, 33.
Pale-green Orchis, 45.
Round-leaved Orchis, 23.
Southern Yellow Orchis, 41.
White Lady's-Slipper, 14.
Yellow Lady's-Slipper, 17.
Smaller Purple Fringed Orchis, 59.
Whorled Pogonia, 76.
Snake Mouth, 65.
Southern Small White Orchis, 34.
Twayblade, 110.
Spider lurking in blossoms, 55, 62.
Sphinx moth, 26.
day-flying, 62.
Spreading Pogonia, 73.
Sprengel, xix.
Striped Coralroot, 143.
Structure of orchids, xvi.

Tall Leafy Green Orchis, 36, 39.
White Bog Orchis, 37, 39.
Terrestrial roots, xiv.
Thoreau, 57.
"Three Birds," 72.
Tipularia unifolia, 145.
Tubercled Orchis, 45.
Twayblade, 103, 125.

Vanilla, 67.

Wasps, 83.
White Adder's-mouth, 122.
Bog Orchis, Tall, 37, 39.
Fringed Orchis, 51.
Fringed Orchis, Prairie, 56.
Orchis, Southern Small, 34.
Whorled Pogonia, 74.
Smaller, 76.
Wide-leaved Lady's-Tresses, 94.
Wister's Coralroot, 140.

Yellow Fringed Orchis, 48.
Lady's-Slipper, Large, 15.
Lady's-Slipper, Small, 17.
Orchid, Small Southern, 41.
Orchis, Crested, 47.

OCT 2 5 1992

WASHINGTON

QK495.064G5
Our native orchids
3 0629 0110168 7

QK
495
064G5